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VOLUME 6, No. 9 SEPTEMBER 1954

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WORLD CROPS

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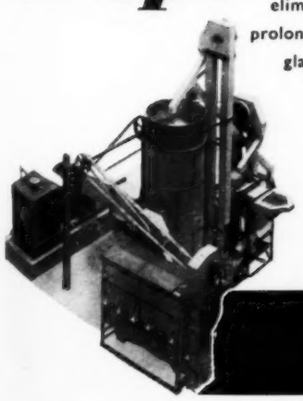

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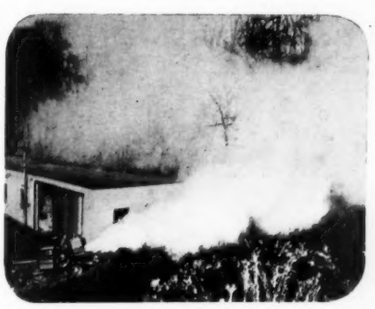

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Editorial Comment

The Rice Commission

THE present number of WORLD CROPS deals more particularly with various aspects of rice production. It is appropriate that this should be so, since in October next the fourth meeting of the International Rice Commission will be held in Tokyo, Japan. This commission was established in 1949 by the Food and Agriculture Organisation of the United Nations to promote international and national action with respect to the production, distribution and consumption of rice. It took its rise in the international rice meeting held at Baguio in the Philippines in March 1948, when the constitution of the commission was drafted; its first official meeting was held in Bangkok, Thailand, in March 1949 and this was followed by other meetings in 1950 and 1952. The forthcoming meeting in Tokyo is officially regarded as the fifth anniversary of the inception of the commission. Since its foundation a number of changes have occurred both in its membership and its activities. The number of countries adhering to the organisation has increased from 10 to 23, while its activities have included the setting up of permanent working parties to deal with two of the major directions in which improvement is urgently needed, *viz.* the breeding of new and more productive varieties of rice and the use of fertilisers in rice cultivation. These working parties have met annually since their establishment and meetings of each will take place this year in Tokyo before the meeting of the commission.

During the five years of its existence a wide range of subjects has been considered by the commission. These have included, in addition to manuring and improved varieties, such matters as the mechanisation of rice production, the utilisation of rice by-products, the development of extension services, nutritional aspects of rice, economic aspects of the rice industry, and the use of rice fields for fish culture. The nutritional and economic aspects received major attention at the first two sessions of the commission and it is accordingly proposed not to accord them a major place in the discussions at the forthcoming meeting, the agenda of which will mainly be devoted to rice breeding and manuring, problems of soil, water and plant relationships, mechanisation problems, operational methods in processing rice and the effects of these on the nutritive value of rice, as well as to the household preparation of rice for human consumption and the use of rice fields for fish culture.

The results of its work

THE commission took its rise owing to the widespread anxiety concerning the critical rice shortage in the immediate post-war period, and it is appropriate to ask what have been the concrete results of its existence. It is, of course, difficult to return a direct answer to this query; but even the most severe critic of FAO and its works would perforce have to admit that the establishment of the commission and its activities do, in fact, represent a major contribution to the solution of a problem of world-wide importance; inasmuch as for the first time it has provided a forum at which the problems of this vastly important, and in many ways unique, industry can be discussed, the results of experience in many countries pooled and examined and recommendations for action communicated to the countries of production.

In general, rice yields throughout the world are depressingly low. Experience in certain countries, *e.g.* Japan, Italy, the United States and Australia, however, shows that, given suitable cultural conditions, they can, in the majority of rice-growing countries, be raised to as much as three times their present level. Increases in yield can be achieved through the adoption of improved cultural methods, better control of pests and diseases, more extensive use of fertilisers and the planting of better varieties of rice. It is important that attention should be paid to all these aspects, but the development of better varieties merits particular attention, because, while irrigation and drainage projects, mechanisation and the provision of fertilisers can confer great benefits, they are costly and involve heavy capital expenditure; plant breeding, however, is one of the less expensive forms of agricultural improvement, and once a new good variety has been produced it pays interest every year in the form of increased yields.

Consequently the work of the commission's rice breeding party is of first-hand importance, since by its annual meetings it ensures collaboration between rice breeders in member countries, while the project for producing new strains by hybridisation between the so-called *indica* and *japonica* strains, located at the Central Rice Research Station at Cuttack in India, should in the long run yield valuable results. Almost equally important is the work of the working party on fertilisers, which has already clarified and co-ordinated results from a number of countries and has provided indications for further work along promising lines. An ancillary development has been the establishment of training centres under the auspices of FAO where workers, both in the field of plant breeding and fertilisers, can receive specialised training in theory and technique.

After a number of years rice production throughout the world has at last reached and passed the pre-war level, and the indications are that, in the immediate future, supplies may be more nearly adequate to meet world demands. How much of this is due to the work of the rice commission may be doubtful; at least a share is due to the fact that seasons have of late been more propitious than immediately after the war. At least it cannot be gainsaid that in focusing attention on the problems of the rice industry FAO has performed a signal service, while it hardly seems too much to believe that in due course the measures at present in progress will lead to the increased production of rice commensurate with the needs of the rapidly increasing populations. But with the amelioration of the supply position other factors are assuming greater importance, notably world prices for rice. From being, before the last war, among the cheapest of cereal grains, rice is now among the dearest—dearer in fact than wheat. It seems probable, therefore, that in the future the commission will have to devote more of its attention to this and cognate economic aspects of rice production.

Fertiliser research

ON both sides of the Atlantic consumption statistics for fertilisers show that the industry producing these substances has doubled or trebled its size and importance in a decade and a half. If in some Western countries consumption is now expanding more slowly, there are few signs of contraction. A recent American opinion (in *J. Agric. and Food Chemistry*, **2**, 648, 1954) emphasises the need for more research, both fundamental in nature and technological. 'Where should this research and development be done? Much of it is being done by Government laboratories. Some, but all too little, is being done in university laboratories. The fertiliser industry itself must support the bulk . . . and is doing so already in the various company laboratories and pilot plants. The industry does not support a research institute such as many industries find desirable. Neither is the industry as apt as many others to support research on fertiliser production in universities. These are possibilities that might be thoughtfully considered. . . . '

To a considerable degree these U.S. research arrangements are closely paralleled in this country, though the production research activities of Government laboratories here can only be described as small. D.S.I.R. investigations since the war seem to have contracted after making an interesting but small-scale beginning. Over the years the universities have displayed little interest in the chemicals that are used as fertilisers, save, perhaps, for chemical engineering studies associated with the development of nitrogen fixation. But it is notable that Scottish Agricultural Industries Ltd., who produce about half a million tons annually, have this summer opened their new and impressive research laboratory at Leith, and one of the main points made by Mr. E. P. Hudson, technical director, at the opening ceremony was the importance of co-operation between university and industrial research. The interchange of knowledge and the cross-fertilisation of ideas with academic workers in similar fields is one of the most fruitful pathways of research. Conducted in this spirit the research done by the industry itself should not be inadequate even for the most impatient critics. Nor should it be forgotten that considerable sums of public money are annually devoted to research on fertiliser usage, and it is probably more profitable to invest any additional Government money that may be available in this already established field.

Subsidies

IT is steadily becoming more fashionable to criticise the payment of subsidies to food producers. This, of course, is one consequence of persistently high taxation. Nothing makes taxpayers more sensitive to debits in national accounts than budgets that bring them no relief. Side by side with this feeling of resentment there is a growing sense of food plenty. Little or no rationing is left in the free world; every harvest brings reports of rising surpluses in America. It will require leadership of a very high order and perhaps great statesmanship to ensure that short-term illusions about agricultural economics do not overwhelm long-term realities. The world is not amply supplied with food or even with food-producing potentialities. The distribution of food is so bedevilled by international friction and by currency restrictions that plenty embarrasses some regions while scarcity weighs down upon others. Any changes in these conditions, the lessening of friction or the easement of currency exchange problems (and let it be noted that neither condition is within the control of agriculturists), would soon reveal a much more precarious balance between world food supply and world food demand. Nor is this all. An intensification of international friction could show even more swiftly, at least for Western Europe, that food production on the spot is worth a great deal more calories and protein than stocks of food abroad.

The situation in Britain is undeniably dangerous. The 1947 Agriculture Act puts the Government in a 'heads-you-win-tails-I-lose' position for the 'guaranteed-price' crops and commodities. Producers retain the option to sell elsewhere and at other prices but at the same time they have guaranteed minimum prices and markets assured by the British Government. On a falling market a bill of somewhat uncontrolled size may be presented to the taxpayers; on rising markets the farmers have an opportunity to make good profits. As a long-term sustainment of farming effort there is much to be said for this system. It can, however, lead to short-term payments that antagonise public opinion.

A useful contribution was recently made by H. Frankel of the Oxford University Agricultural Economics Research Institute. In an article in the *Westminster Bank Review* he draws the important distinction between subsidies that have the purpose of encouraging long-term improvement of land, *e.g.* lime and fertilisers, livestock, equipment, etc., and subsidies that insure the farmer against price fluctuations; he suggests that a shift of emphasis from the latter to the former might well be more effective. This is surely the most practical approach. Money is much more wisely spent in promoting greater efficiency and lower production costs than in perpetually insuring farming effort that has a widely varying standard of economic efficiency.

Manuring coffee

COFFEE is a crop for which comparatively little reliable information is available about its manurial requirements. There is, in East Africa, a certain amount of data regarding the results of manurial experiments carried out by the Kenya Department of Agriculture, by the Lyamungu experiment station in Tanganyika and by various planters. In many countries, it is true, there is a mass of opinion on the subject but much of it is the outcome of what planters think the coffee plant ought to want rather than on any firm basis of ascertained fact.

In 1944, however, the Kenya Government acquired a coffee estate at Ruiru with the object of establishing a coffee experiment station charged with the duty of endeavouring to elucidate the major problems of the industry. At this station, the area of which is some 300 acres, a series of manurial experiments were laid down of modern factorial design intended to establish with confidence the response of Arabian coffee to various manurial treatments. The first results of these have recently been summarised in a paper in the *Empire Journal of Experimental Agriculture* by Messrs.

H. C. Pereira and P. A. Jones. The earlier work in East Africa referred to above had indeed shown that applications of various forms of artificial manures to coffee gave very variable and sometimes negative responses. None of the records, however, supported the general expectation that there would be large responses to cattle manure or to phosphates, although they confirmed the view that there would be little or no response to potash or lime. Nitrogen fertilisers gave irregular results and needed further elucidation.

Later experiments at Ruiru and elsewhere confirmed many of the earlier findings and showed conclusively that over the range of conditions in Kenya neither the yield nor the quality of the coffee crop were affected by heavy applications of either pen manure or phosphates, although crop yields were sometimes raised when nitrogenous fertilisers were given at heavy rates.

Coffee yields depend greatly on the annual rainfall, and soil moisture measurements showed that important additions to the moisture conserved in the soil could be achieved by applying grass mulches. The value of grass mulches had been previously established at Lyamungu experiment station, and the work at Ruiru confimed this, showing that large increases in yield occurred when grass mulches were applied before the rains. The mulches greatly improved soil structure, while better results followed the application of organic matter in grass mulches than by converting it into farmyard manure and digging it in. Considerable amounts of nutrients are applied in mulches provided they are adequate in amount and their use obviates the need for other forms of manuring, since the amount of plant food conveyed in them can considerably exceed the amount removed in the coffee crop.

It is certainly an achievement to have succeeded in elucidating the problem of manuring coffee to this extent. It seems that normally the soils of the coffee growing areas in Kenya are fairly well supplied with potash but markedly deficient in phosphates. It is surprising that in these conditions the response to phosphatic manuring should have been negative. The conclusion reached is that for coffee cultivation areas should be reserved for the production of grass for mulching the crop, and that in order to meet the requirements of the coffee crop periodic applications of fertilisers should be made to the plots whence the grass is obtained rather than to the growing coffee.

Seed inspection

BRITAIN'S Cereal Seed Inspection Scheme will be eight years old with this year's harvest and in rough figures over 70,000 acres will have been periodically inspected compared with 35,000 acres in the scheme's first year. There is nothing new about field inspection as a major method of ensuring seed purity, but until the war it had been relatively unorganised, and even during the war the various regional and county schemes lacked uniformity. A national scheme that would standardise varieties, inspection values and terminology was badly needed and soon after the war the seed trade as a whole welcomed the proposals drawn up by the National Institute of Agricultural Botany. This scheme aims at varietal authenticity—correct description, purity of stock, and freedom from weeds and disease. Initially, of course, progress was slowed by the scarcity of qualified inspectors, but instruction and refresher courses run by the N.I.A.B. have steadily helped to overcome this problem. Crops being grown for seed are inspected several times: in the late spring, an important time for checking weed and winter damage; in June, when loose smut and other diseases can be assessed; and after the ear has turned, the crucial time for purity count and for determining the roguing programme. A fourth inspection after roguing is commonly required.

The scheme is operated in two ways, through local seed growers' associations or by seed merchants. Originally N.A.A.S. officers carried out the inspections for the seed growers, but today this work is carried out by merchants' trained inspectors for both systems of the scheme's operation. N.I.A.B. inspectors regularly carry out their own inspections as a check upon the general standard of inspection, and this impartial 'umpiring' seems to be working smoothly and happily. The fact that in such a short period the acreage inspected has doubled is a self-evident sign of success. How far it has yet contributed towards Britain's steadily rising level of cereal yields per acre is impossible to estimate. It may well be that the most striking benefits are still to be expressed; better quality seed for older varieties can improve the national yield just as much as the introduction of newer high-yielding varieties.

Output per man

A NEW report from the Farm Economics Branch of the Cambridge School of Agriculture ('Planning a Farm for Higher Productivity,' 1954) raises serious queries about the productivity advances of British farming. Although output per man has increased since 1939 by about 30%, it is pointed out that a large part of this increase has come from higher yields and improved techniques, *e.g.* through the use of more fertiliser and from better seed varieties. If these sources of gain are allowed for quite conservatively, the residual gain attributable to productivity per man is not more than 15%. 'While such an increase is very well worth having, it seems small in comparison with the potentialities of the machinery used. . . . It would be even less impressive if account were taken of the additional man-hours spent in factories and repair shops in the manufacture and upkeep of this machinery.' We are reminded of our own recent comments on the subject of the tractor versus the horse (see WORLD CROPS, **6**, 220, 1954).

The Cambridge report puts forward several possible reasons for the smallness of the productivity increase that has followed such a huge introduction of machinery (estimated at a 275% increase since 1939). First, there has been some reduction in hours worked per week and holidays have increased. Second, more time is spent—and rightly—upon maintenance; before the war this was seriously neglected on most farms. Third, the incidence of high taxation on farmers' incomes—at any rate on the large farms—acts as a disincentive for reorganising farm staff. Machinery might enable a farm to be run with one or two men less, but this makes greater demands upon management; though the gross savings in money per year might be appreciable, the

actual gain for the farmer's personal income, after taxation, is very much smaller, and may not in many cases be worth the extra personal work involved. But probably the most important reason is that ' mechanisation has not yet been fully integrated into the farming system.' This, perhaps, can be alternatively worded : ' farming systems have not yet been adapted to be able to derive the fullest benefits of mechanisation.' Thus, machines introduced singly may lighten the labour demands of certain seasonal tasks, but a staff large enough to deal with other and unreduced seasonal tasks must still be maintained. Not until the range of mechanical invasion lightens all the seasonal tasks can labour be substantially saved.

If this final view is correct, it implies that much more mechanisation of farm tasks is required before mechanisation can show its full return. Yet again high taxation stands in the way of greater outlay—already more and more capital is needed merely to maintain the current inventory of machines.

Better timber

TIMBER and not trees themselves constitute the end-product of forestry, and it is by this end-product that wood, as a crop, is so often judged. It is not widely appreciated that the seasoning of timber receives far more scientific attention than it did before the war. Soon after the establishment of the Forest Products Research Laboratory at Princes Risborough (Buckinghamshire) it was decided to organise training courses in timber-drying kiln operation. ' It was felt that the skill of the operator might be a more important factor than the efficiency of the kiln, since he could do much to minimise the shortcomings of imperfect design.' This training scheme began informally on a small scale; thus, in 1928 only nine trainees from industry were handled. But gradually the facilities became better known and after 10 years the number of trainees coming forward each year required the organisation of a more formal instruction course; even so, this involved in 1938 only two set courses a year, each limited to 20 trainees. The war transformed these arrangements. By 1943 kiln operation courses were being held every fortnight! With the passing of war-time urgency this demand for training did not fade, as might well have been expected. Today courses are given at intervals of from six to eight weeks throughout the year, and they are attended not only by operative workers from the British timber industry, but also by executives and colonial students.

It is not claimed, of course, that the full art of kiln operation can be taught in a week's course. But it is found that trainees acquire enough knowledge to cope with the simpler and common problems, and when they encounter unusual problems they refer these to the Princes Risborough centre for special advice. Research by itself can achieve little; it is the extent to which new and improved technology is actually applied in day-to-day industry that determines research results. These regular courses have served a much wider purpose than that of elementary training—they have forged a link between timber science and several hundred key workers in the British industry. This is by no means a remote topic so far as agriculture is concerned, apart from the fact that timber is a crop. Would not the application of modern scientific methods in farming be speeded up if similar courses were regularly available in some of our principal research centres? The current tendency to segregate agricultural research and education is not wholly wise. Moreover, we know little of the stimulus that might be given to key workers on farms if they could take short-term practical courses at research centres; most of our agricultural training is given to future farmers and farm managers whose practical experience has yet to develop.

Lime—the cinderella?

AT a time when so much more attention is being given to fertiliser potentialities, at any rate in all but the most backward countries, the vastly inferior progress in lime application is absurdly paradoxical. Lime is a relatively cheap material; in most countries it is fairly abundant and the practice of adding lime to soils is one of the most ancient in agriculture. Why it should be so neglected when plant growth and fertiliser efficiency depend so much upon the pH status of soils is a modern mystery. Perhaps the emphasis laid upon liming by advisory services is too slight or is nowadays overshadowed by the pressures for other soil-amending practices?

Enquiries made among member-countries by OEEC have shown that in most of them a large proportion of farming soils are lime-deficient. The amounts of lime annually applied are insufficient to compensate for annual losses so that no contributions are being made towards reducing the heavy lime deficits inherited from the past. Thus the calculated annual loss of lime from French agricultural soils is 3,500,000 tons (as calcium oxide); the tonnage applied each year is only 600,000 tons. In Western Germany the annual requirement is 4,000,000 tons but, in fact, only 1,000,000 tons are applied. England and Wales have an annual loss of 1,750,000 tons but in contrast to most of Western Europe a little more than this amount is applied, 2,000,000 tons; however, the total deficit is 14,000,000 tons so that even at this rate of progress it will take well over 50 years to conquer the lime deficiency back-log. Yet it is certainly not unrealised that liming deficient soils can lead to substantial and sometimes spectacular crop responses.

One conclusion drawn in OEEC studies of this problem is that the services for lime application are poorly organised in most European countries. It is notable that Britain and Belgium, who have well-organised services and are cited as examples to follow, are making better progress than most in reducing their lime deficits. Is it because lime is a cheap material that so little modern progress has been made in organising its commercial distribution? Does the business of supplying lime to farms offer too small a return upon investment? Yet farmers themselves would not seem to consider lime as a cheap material. The increase in British use has largely resulted from the introduction of a generous subsidy scheme; subsidy schemes also operate in Norway, Denmark and Eire.

It seems clear enough that lime shortages in soils will increasingly appear as limiting factors to crop production unless a much greater readiness to use lime can be stimulated in Western European farming.

The World Rice Situation

An Outline Survey

RICE shares with wheat the position of being the world's most important cereal. It is not merely traditionally the staple food of the teeming millions of many Asian and some African countries; it is often the only substantial item in their diet. It is, moreover, an important article of diet in many other countries all over the world.

Even before the last war available supplies of rice were insufficient to provide a full diet for large numbers of the inhabitants of Eastern countries. The war itself greatly reduced production in many countries and interfered with the transport of supplies from countries in which production was unaffected directly by hostilities. After the conclusion of the war shortages continued and gave rise to a situation which caused grave concern to world governments and to the United Nations Organisation. This shortage lasted with variations in intensity until 1952 and was reflected in high prices for rice. The shortage was enhanced by the rapid increases which are taking place in world populations, especially in the Far East. By the end of 1952, however, rice growers in many countries succeeded in harvesting larger rice crops, aided by various forms of government assistance and assisted by the occurrence of favourable seasons.

In consequence, the rice shortage began to ease in 1953 and simultaneously other cereals, notably wheat and barley, began to appear more freely on the world's markets. In many consuming countries it was felt that this improvement in the situation should find its reflection in lower market prices, a view which, however, was not shared by some of the main exporting countries. This led to a marked lessening in international trade in rice in 1953 and stocks began to accumulate in some countries. These are, however, small as compared with world consumption, but if present trends continue during the current year they may become considerable, when they are bound to exercise an increasing influence on prices. In what follows production and consumption conditions in the leading regions of the world are briefly reviewed.

Production and consumption of rice

While varieties of rice exist which can be grown as dry-land crops like other cereals, their total production at present is insignificant compared with the bulk of the world's rice crops, which consist of ' swamp rice ' which for the bulk of its life is grown partially submerged in water. For this reason the main areas of rice production throughout the world lie on the alluvial plains and deltas of great rivers or in marshy regions which have been reclaimed and drained.

The world rice situation, so far as production is concerned, has appreciably improved in the last two years, while prospects are that supplies will further increase in the near future. The position is reviewed in outline in what follows, and some account given of the outlook.

The largest areas of production and consumption lie in Asia; indeed, despite the changes brought about by the 1939-45 war and subsequent hostilities, 92% of the world's total rice production is still grown and consumed in Asia. All the principal countries of South-East Asia produce rice, but the majority are not self-sufficient and depend more or less on imported supplies.

The total world area under rice before the 1939-45 war is estimated to have been roughly 211 million acres (excluding Soviet Russia), while the total world production in terms of paddy was approximately 151.2 million metric tons, roughly equivalent to 105 million tons of milled rice.

During the war world production fell considerably, reaching a minimum of 125 million metric tons of paddy in 1945. Subsequently it recovered to 154 million tons in 1948, but in subsequent years it fell again, averaging 151 million tons for the three years 1949 to 1951. In 1952-53 it increased to 162 million tons, *e.g.* approximately a 5% increase on the pre-war figure. However, 1952-53 was the first year when production in Asia rose above the pre-war figure, major additions to production having been confined to other parts of the world. Preliminary figures for the 1953-54 season indicate that the high level of production of the previous season has, on balance, been considerably exceeded; in Asia there was a fall in production in Japan, but crops in India and Pakistan were exceptionally good. The harvest in the United States reached a new record, but crops in Europe remained about the same level.

Table 1 summarises the changes in the world production in selected years before and after the war. It is based on information derived from FAO, Commonwealth Economic Committee and United States Department of Agriculture publications.

TABLE 1

RICE: AREA AND PRODUCTION BY REGIONS; PRE-WAR AVERAGE 1946 AND 1950-53

Area (in 1,000s of acres)						
Region	1934-38 *average*	1946	1950	1951	1952	1953
Europe	540	520	690	780	860	840
North America	1,340	2,280	2,580	2,940	2,930	3,160
South America	2,940	5,180	6,100	5,700	6,510	6,490
Asia	202,000	196,000	216,000	216,000	217,000	236,000
Africa	4,510	6,160	7,410	7,240	7,240	—
Oceania	20	50	70	70	70	70
World Total (excluding U.S.S.R.)	211,350	210,190	232,850	232,730	234,610	246,560
Production (in 1,000s metric tons paddy)						
Region	1934-38 *average*	1946	1950	1951	1952	1953
Europe	1,140	790	1,300	1,400	1,650	1,670
North America	1,180	1,900	2,270	2,570	2,790	3,030
South America	1,820	3,600	4,210	3,950	4,510	4,600
Asia	144,800	130,900	139,000	140,000	147,100	153,000
Africa	2,180	3,020	3,700	3,000	3,200	—
Oceania	50	80	90	80	100	110
World Total (excluding U.S.S.R.)	151,170	140,300	150,570	151,000	159,350	162,410

NOTE: Detailed figures of area and production in Africa for 1953 are not yet available.

Production in Asia

Asia is by far the largest continental region of rice production and consumption. Rice is the traditional food of a large proportion of the populations and efforts to popularise other types of food have had comparatively little success. The bulk of the crop is grown on small peasant holdings by crude traditional agricultural methods. Yields per acre are low for the most part, except in Japan, where cultivation standards are higher than elsewhere. The largest producers are India, Pakistan and China, which together account for about 60% of the world's total production, *i.e.* 90 million tons of paddy or 63 million tons of milled rice. The populations of these regions are so dense, however, that normally domestic production does not suffice to meet their needs and they have depended to a considerable degree on imports. Other important rice-producing countries in Asia are Burma, Thailand, Indo-China, Korea and Formosa, together with Japan, Indonesia and the Philippines, but some rice is grown in most Asiatic countries.

Exporting countries in Asia

Burma, Thailand, Indo-China, Korea and Formosa were before the last war the main areas in the world of export rice production. Burma, Thailand and Indo-China together exported annually 6 million tons of milled rice, which caused the region of South-East Asia in which they exist to be known as 'the world's rice bowl.' During the last war Burma was overrun by the Japanese, while the whole region was greatly affected by the war and by strife in the post-war period. As a result the total cultivated area in the three countries, which pre-war was estimated to amount to 37 million acres, fell to about 26 million acres, paddy production fell from 17½ million tons to 12 million tons and exports of rice from over 6 million tons to under 1 million tons.

Since 1945 considerable recovery has occurred, but it has not been uniform in all three countries. Thailand is the only one in which production has expanded beyond the pre-war figure; today she is the world's largest exporter of rice, although production fell in 1952 somewhat below the maximum attained in 1951; in 1953, however, it recovered to the former level.

Burma has also made a considerable recovery, although production is still below the pre-war level, while exports, after rising to a maximum of 1,268,000 tons in 1951, declined in 1953 to 971,000 tons.

Indo-China has continued to suffer from the condition of warfare that has prevailed there during the past nine years. Production is estimated to have been considerably below the pre-war level, while exports have fallen to about one-sixth of their pre-war volume.

TABLE 2

ESTIMATED PRODUCTION OF RICE IN 1,000s OF TONS OF PADDY					
	Pre-war mean 1937-40	Post-war 1946	1951	1952	1953
Burma	6,950	3,680	5,500	5,841	5,796
Thailand	4,200	4,100	7,325	6,602	7,700
Indo-China ..	6,540	—	4,560	4,604	—
EXPORTS OF MILLED RICE IN 1,000s OF TONS					
	Pre-war mean 1937-40	Post-war 1946	1951	1952	1953
Burma	3,070	425	1,268	1,261	971
Thailand	1,338	442	1,612	1,413	1,342
Indo-China ..	1,436	98	333	230	215

NOTE: Figures for production in Indo-China in 1953 are not available.

The production and exports of rice of these three countries for the past three years and for the immediate post-war and pre-war years are shown in Table 2.

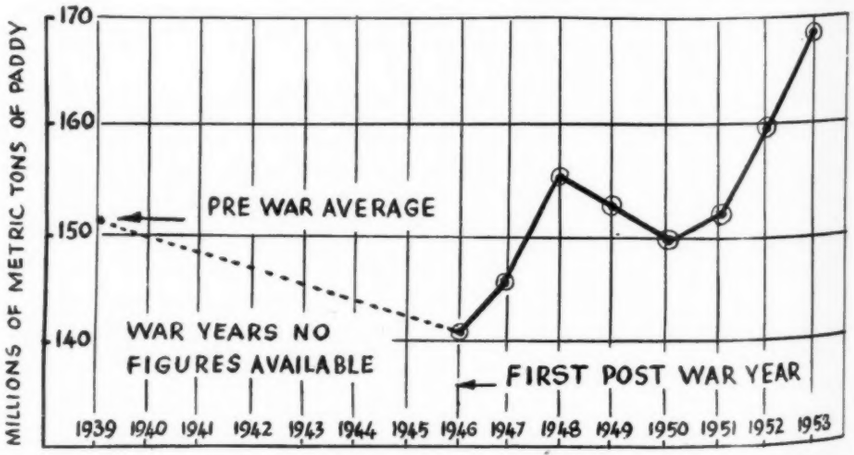
Korea and Formosa were also before the war considerable exporters of rice. Korea produced over 4 million tons of paddy and exported 1 million tons of milled rice, almost all to Japan. Production in Formosa amounted to 1,700,000 tons of paddy and exports to 670,000 tons of milled rice. Korean exports of late years have been negligible and production is estimated to have fallen to about 2 million tons of paddy. Production in Formosa fell during the war, but of late years has revived; for 1951-52 it is estimated to have reached 1,900,000 tons of paddy—higher than pre-war—and exports have amounted to 170,000 tons of rice.

Importing countries in Asia

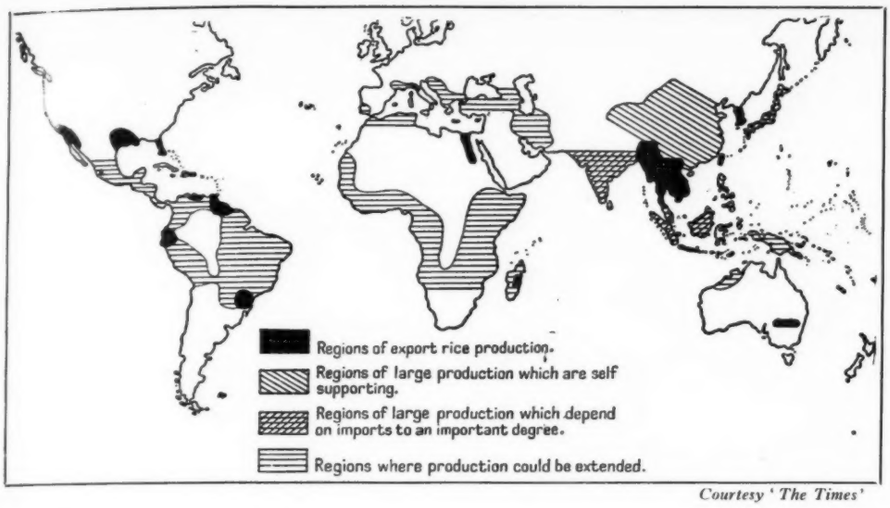
India was before the war the largest importer of rice in the world. Imports for the period 1934-38 averaged over 2 million tons of milled rice annually. She was also, after China, the largest producer, the total production averaging for India, including Pakistan, 46 million tons of paddy. Since the war, despite a considerable increase in the area cultivated, production in India increased but little until the last two years owing to a succession of bad seasons. In 1952, however, it showed a definite improvement, having amounted to an estimated total of 34 million tons of paddy for India alone, which further rose to 41 million tons in 1953. Indeed, it is reported that during the current year there have been some exports of rice from India. In Pakistan also production has increased by over 1 million tons to close on 14 million tons in 1953.

Imports of rice into India have fallen to less than half the pre-war figure on the average of the years 1948-52. During that time they were replaced in part by imports of other grains, notably wheat. Pakistan is beginning to figure as a rice-exporting country and exported over 100,000 tons of rice in 1951.

Reliable figures for rice production in China are difficult to obtain. Production is estimated to be in the region of 40 to 50 million tons of paddy annually. Recent crops appear to have been good and of late years China has ceased to be an importer.


MILLIONS OF METRIC TONS OF PADDY
170
160
150
140
PRE WAR AVERAGE
WAR YEARS NO FIGURES AVAILABLE
FIRST POST WAR YEAR
1939 1940 1941 1942 1943 1944 1945 1946 1947 1948 1949 1950 1951 1952 1953

World production of rice in millions of tons of paddy before and after the war of 1939-45 (U.S.S.R. excluded)


Regions of export rice production.
Regions of large production which are self supporting.
Regions of large production which depend on imports to an important degree.
Regions where production could be extended.

Courtesy 'The Times'

In 1952, in fact, she is reported to have exported some 200,000 tons of rice to Ceylon.

Japan and Indonesia are large rice producers, but production does not suffice to meet all needs and there is dependence on imports. Japan annually produces 11 to 12 million tons of paddy and imports roughly 1 million tons of rice, while Indonesia produces 11 million tons of paddy and imports approximately 300,000 to 400,000 tons of milled rice.

The Philippines until recently were also considerably dependent on rice imports, but for some years past the Government have made considerable efforts to reduce this. Pre-war production averaged approximately 2 million tons of paddy, while imports ranged round 100,000 tons of rice annually. Recently, however, production has risen to over 3 million tons and imports have ceased.

Malaya and Ceylon have long been rice importers on a considerable scale. Both Governments have made considerable efforts to increase rice production, but, despite appreciably increased production—notably in Malaya, which now produces 600 to 700,000 tons of paddy annually—dependence on rice imports remains large. Of late years imports into Malaya have ranged around 500,000 tons and into Ceylon around 400,000 tons annually.

Rice production in Africa

Rice is grown in many African countries, natural conditions suited to rice production existing in many territories, and especially in some British dependencies considerable efforts are being made to encourage production. The largest producers in the African region are Egypt and Madagascar. The total production of paddy in Africa in 1952 was estimated to be 3,200,000 tons; in 1950 Egypt produced 1,200,000 tons of paddy and Madagascar 770,000 tons. Formerly Egypt was a not unimportant exporter of rice, having exported from 200,000 to 300,000 tons of rice annually between 1947 and 1951. Of late years, however, production in Egypt has greatly diminished and exports have ceased.

Transplanting rice in South-East Asia

Rice production in Europe

Rice has for many years been an important summer crop in Italy and also to a smaller extent in Spain, Portugal, Bulgaria, Jugoslavia and Greece. Since the war it has begun to assume important proportions as a summer crop in a number of other southern European countries, including Southern France and Hungary, while its cultivation in Jugoslavia, Bulgaria, Roumania and Greece has increased. It is also grown in Southern Russia, although no details are available.

Before the war the total European production amounted to 1,140,000 tons of paddy, of which 790,000 tons were produced in Italy. During the war European production fell, but has since expanded to a total of 1,670,000 tons of paddy in 1953, of which Italy produced 926,000 tons; in 1952 she exported 230,000 tons of milled rice.

Rice in the Americas

Rice is extensively grown in North, Central and South America. In North America the only producer is the U.S.A., where the crop has for many years been grown in the southern states and in California. Before the war the average total production was 1.2 million tons of paddy. Since the war production has considerably increased and in 1953 it amounted to 2.4 million tons of paddy. Exports before the war amounted to 70,000 tons, but they had expanded in 1952 to close on 750,000 tons of milled rice. In Central America nearly all states produce varying amounts of rice, but there are practically no exports. Mexico is the largest producer; production amounted to 152,000 tons of paddy in 1953.

In South America many countries grow rice; the total area and the production have grown greatly during and since the war, as have exports also. The largest producer is Brazil, where production expanded from 1.36 million tons of paddy pre-war to 3.18 million tons in 1953. Exports from South America have grown from 60,000 tons of milled rice pre-war to 260,000 tons in 1952.

Rice in Oceania

Rice production in Oceania is mainly confined to Australia. It is, however, also cultivated in Fiji and other British territories for local consumption, and in some of the territories administered by the French High Commission. In Australia rice growing developed as a result of the

Ploughing paddy fields in Ceylon after heavy rain

Ploughing paddy fields in India with a rotavator

inception of the Murrumbidgee River Irrigation scheme in New South Wales; efforts to develop rice growing are also being made in the Northern Territories and the north of Western Australia. The area grown and production have expanded since the war and there is some export trade. The total production of Oceania was estimated to be 110,000 tons of paddy in 1953, while exports from Australia totalled 22,000 tons in 1952.

Rice yields

Rice yields vary very much with the conditions under which the crop is grown. Climatically these may range from fully tropical, as in South Asia, Central Africa and Central America, to semi-temperate, as in Japan, parts of China, Australia, the U.S.A. and Southern Europe. Cultivation methods range from the primitive traditional methods of Asia and Africa to the highly specialised and mechanised methods current in the U.S.A., Australia and parts of Europe.

The following table based on data adduced by the Commonwealth Economic Committee shows the variation clearly:

TABLE 3

Mean yield of paddy per acre	
	cwt.
Italy	39.9
Australia	33.0
Japan	30.0
U.S.A.	18.4
Indonesia	12.3
Thailand	11.5
Burma	10.9
Pakistan	10.7
India	10.3
Ceylon	6.7

It is remarkable that the yield of paddy per acre should in Italy and Japan be five to six times as high as in Ceylon and three to four times as high as in India. The difference is certainly due in part to better cultivation, etc., but in part it may also be due to the greater summer day length in temperate latitudes, which conduces to high yields, the crop being photo-sensitive in this regard. There is no doubt, however, that yields in tropical countries could be greatly raised by improved cultivation, better irrigation and drainage, manuring, improved varieties and so forth. Indeed, if the returns per acre in South Asia could be raised to even half those obtained in Italy, Australia or Japan, the problem of rice supplies would be solved. As it is, production in Asia had until 1952 failed to expand beyond the pre-war mark, while the populations of the rice-consuming countries have grown by over 11%. Moreover, exchange difficulties at present preclude rice from the countries in the western hemisphere, where production has most increased and a surplus exists, being fully available to the deficit countries of the East.

Outlook

It is encouraging that in 1952-53 production in Asia should at last have shown some increase compared with pre-war; the United Nations' World Rice Conference at Baguio in the Philippines in 1948, however, considered that an annual increase in world rice production of 1.3 million tons is essential to safeguard the position. Complete figures for 1953-54 are not yet available, but so far there is every indication that they will continue to show further increases. The most striking gain is in India, where the reported crop of over 40 million tons of paddy represents an increase of 20% over production in 1952-53 and 30% over 1951-52. So far as the 1954-55 crop is concerned, the only indication available at present is for the U.S.A., where it is anticipated that the acreage to be sown will represent an increase of 8% over the record acreage planted in 1953. During 1953 world trade in rice contracted considerably, but at present world shipments are expanding and appear likely to continue to increase during the rest of the year in fulfilment of government to government contracts made some months ago.

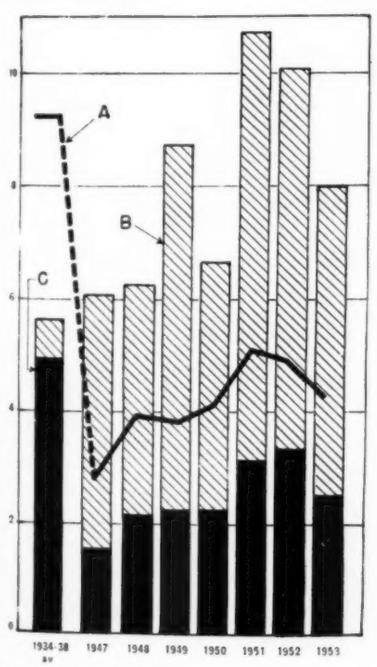
Rice imports

The annexed graph copied from the FAO monthly bulletin of statistics illustrates the annual fluctuations in rice imports into the six principal rice importing countries in the Far East, pre-war and during the past six years, and gives an indication of the trend of events. It seems that the controlling factor is probably the high prices which have prevailed for rice and, although these show a downward trend of late, they are still high compared with other cereals. There is still plenty of scope for an increase in the import demand for rice provided buyers find the price attractive. As it is, one of the most remarkable things is that cereal imports into the Far Eastern region contain a far lower proportion of rice than formerly. No doubt the taste and predilection of consumers in the Far East is for rice in preference to other

grains, but the high prices are certainly a strong factor in influencing the consumption of cereals other than rice; for whereas in the pre-war period rice composed 75% of total cereal imports, of late years the position is reversed and other grains make up 60% to 70% of total grain imports. Obviously a readjustment in price relationships for grains would go far towards enabling rice to increase its share of grain imports in the rice deficit countries. No doubt high prices for imported rice and restrictions on trade by reason of exchange difficulties are having some effect in stepping up rice production in the East, a fact which the restoration of peaceful conditions in Indo-China following the Geneva conference should materially influence also.

Acknowledgments

Free use has been made of the reports and publications of FAO, the Commonwealth Economic Committee and the United States Department of Agriculture in preparing this summary. Acknowledgment is also made to the London *Times* for permission to use part of an article by the writer on the rice situation published in *The Times* Colonial Supplement for the winter of 1953. H.T.

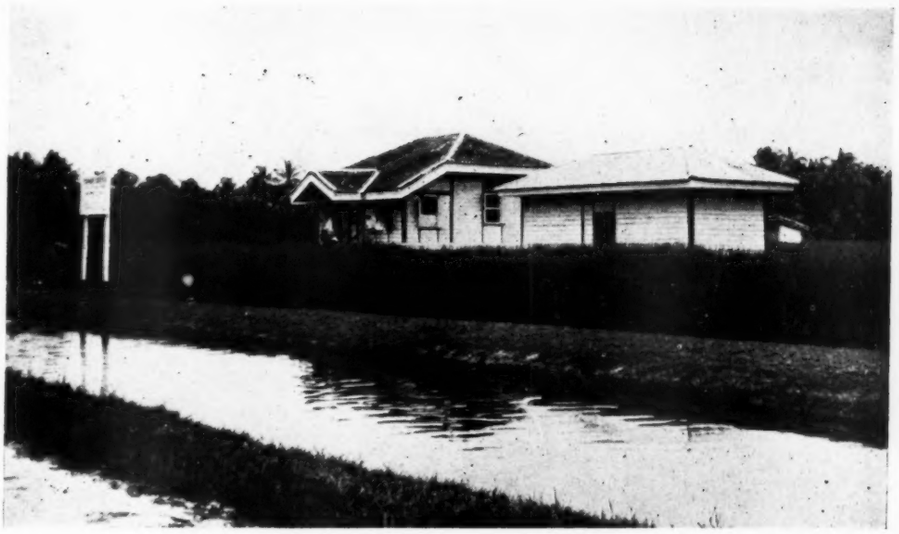


A World imports of rice
B Net imports of other grains into the six Far-Eastern countries
C Net imports of rice into the six Far-Eastern countries

Graph: FAO

World imports of rice and net imports of rice and other grains in six Far-Eastern countries, 1934-38 average, 1947-53 annual

NOTE : Other grains include wheat and wheat flour, rye, barley, oats, maize and sorghum and millets. The six countries are Ceylon, India, Indonesia, Japan, Malaya and the Philippines.



An experimental rice station in Malaya

Fourth World Forestry Congress

More than 300 delegates from all parts of the world are expected to attend the Fourth World Forestry Congress, which will open at Dehra Dun, India, on December 11, continuing until December 22. The congress, which is being organised by the Indian Government in co-operation with FAO, will differ in a number of ways from the earlier meetings held at Rome (1926), Budapest (1936), and Helsinki (1949). It is, for example, the first time that the congress has been held outside Europe and, although some aspects of utilisation of tropical timbers have been briefly considered at previous congresses, it is the first occasion on which special emphasis has been laid on tropical forestry. The 1949 congress recommended that a world congress on tropical silviculture be held, and at its sixth session in 1951, FAO's conference decided that this should be incorporated in the next World Forestry Congress. For this reason, more importance than usual is attached to the tours which are being held in conjunction with the congress. These tours, besides covering many of the finest forest areas in India, will take delegates into neighbouring Pakistan, whose government has offered full co-operation in enabling delegates to see her own famous forests.

Dehra Dun, where the congress is being held, is already known throughout the forestry world as the site of the Indian Forest Research Institute. It stands in the shadow of the Himalayas, thus providing an added attraction for delegates, who will have some of the world's finest scenery and most impressive forests on their doorstep during the congress.

Finally, this congress differs from its predecessors in being linked with a world-wide drive to bring home to people in every corner of the globe the part that forests play in their own lives. From the point of view of the technicians, the theme of the congress has already been summed up as ' the place of forests in the general land economy and economic development of a country '; from the more popular point of view, this subject can be called, simply, ' Forests and Man.' For forests, besides providing (in wood) the world's most widely used raw material, have functions in regard to the protection of the soil and the conservation of natural resources.

Potato Blight in England

No outbreaks of blight on maincrop potatoes had been reported by July 1, but outbreaks on early varieties had occurred in Cornwall, Devon, South Wales, Anglesey, the West Midlands and the Holland and Kesteven Divisions of Lincolnshire. Spells of ' blight weather ' were reported by some meteorological stations in each region of the country in mid-June, but, in general, such spells in mid-June were too early to lead to outbreaks of blight on maincrops except in the South - West. Elsewhere in the country the state of the maincrop plants was unusually variable. Some were forward and meeting across the drills; others were still small and barely meeting along the drills.

The Possibility of Increasing Rice Production

D. H. GRIST

This article briefly summarises the main requirements of the rice crop. The author, Mr. D. H. Grist, is well known as an authority on rice cultivation, has had lengthy experience of the crop in the Far East and has also visited British Guiana. He is the author of a recently published book on the subject, while articles on rice cultivation from his pen have appeared from time to time in WORLD CROPS.

SINCE rice is the staple food of many millions of people in Asia and enters into the diet of about half the world's population, it may be fruitful to examine and summarise some of the salient features concerning the cultivation of the crop and methods to improve the industry, as well as the nutritional value of the grain.

Climate and soil

Paddy will grow under a wide range of climatic conditions provided that sufficient water remains on the land until the crop approaches maturity, and it can produce a crop even on soils that are very poor in plant nutrients. The highest yields are obtained in sub-tropical and warm temperate climates, possibly owing to the longer day length during the growing period and to the occurrence of cold winters which may favourably influence soil conditions.

The semi-aquatic conditions under which rice is grown necessitate a heavy soil through which irrigation water will not readily percolate, for the demands of the plant as regards water are more precise than are its demands on quality of soil. There is evidence, however, that it grows better on heavy clay soil than upon lighter soil containing a high proportion of sand; but, provided that sufficient water is available to maintain irrigation, satisfactory crops are frequently obtained on quite sandy soil if they are given dressings of organic matter in one form or another and are heavily fertilised. Good paddy soils are almost invariably acid in reaction, the *p*H value usually varying from about 4 to 6. Acidity has a profound influence on the uptake of manurial elements and also on the character of the root system.

The presence of an excessive amount of peat is a limiting factor to paddy production, and it may well be that much of the vast areas of swamp land awaiting development will be found unsuited to paddy cultivation on this account.

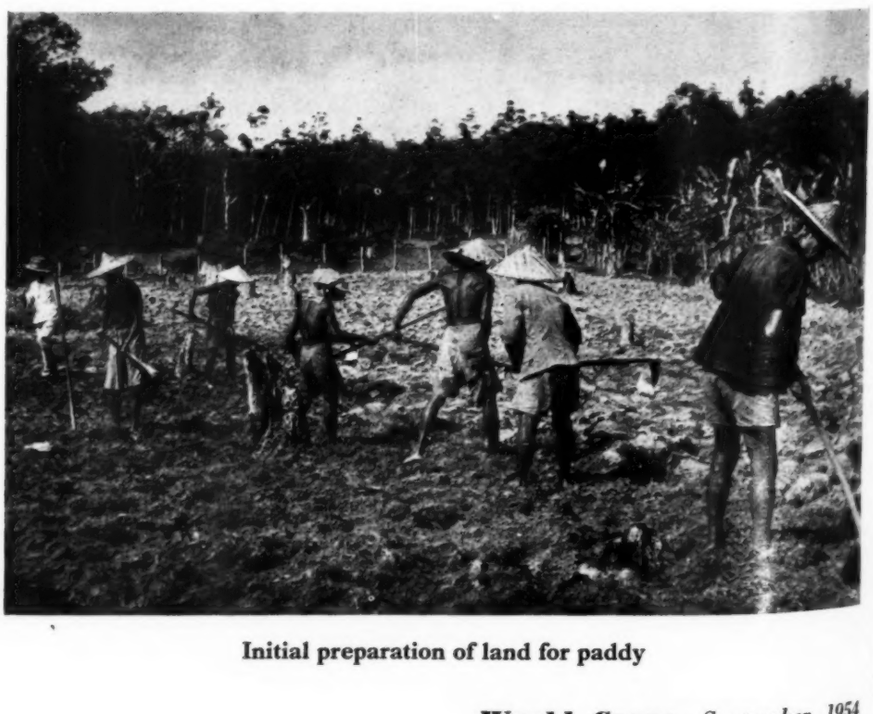
Water

Irrigation and drainage are the most important conditions in paddy cultivation. To obtain optimum yields, the crop should be planted in a well-soaked field but with no excessive standing water; the depth of water being increased as the plant grows, until a depth of 6 to 12 inches is obtained. The water should be in a state of gentle movement over the land and stagnation avoided. Deep water inhibits tillering and thus results in decreased yield. Water requirements of the crop vary from 2 to 6 acre feet, the amount depending on climatic and soil conditions and greatly on the degree of control which can be exercised over the water.

While much work on improving drainage and irrigation has been carried out in many countries of paddy production, in many areas it remains inadequate. Improvements in this direction would prove the most important factor in paddy cultivation.

Varieties

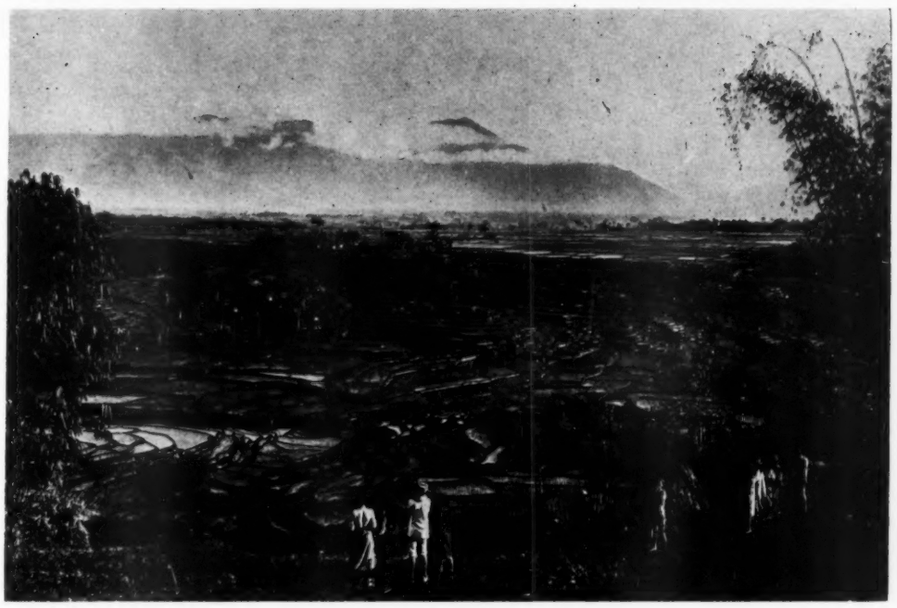
The varieties of cultivated rice are legion and the differing characters exhibited by them enables the crop to be successfully grown over a wide range of climatic and cultural conditions. Varieties differ in shape and size of grain, in growth, in aroma and cooking quality, in their demands on soil and water, in maturation period and in many other respects. The main task is to fit the variety to the environment. While on extensive plains soil conditions are usually reasonably even over wide areas, in many riverine areas soil conditions vary considerably, so that several varieties may be necessary over comparatively short distances. This multiplication of varieties leads to mixing and to a consequent diminution of yield. Even in the highly mechanised system employed in the United States, where the varieties are limited in number, this mixing of varieties remains a problem. In this case it is usually due to incomplete cleaning of



Initial preparation of land for paddy

the threshing machinery between visits to different farms.

Considerable attention has been given to the improvement of varieties by selection and breeding to meet the needs of particular areas. In Asia the varieties usually grown are frequently so mixed that marked improvement in yield may be obtained in one or two years by simply carrying out field selection based on a single character. While this work of selection is of great value, in the long run the production of new varieties may be expected to give the best results, since not only can this system provide higher-yielding types, but it can also be used to eliminate or reduce losses from such causes as lodging, and to improve resistance to pests and diseases.



Paddy fields near Garoet, Java

Pests and diseases

Paddy is subject to insect pests at every stage of growth. The worst pests are plant bugs, stem borers, army worms and grasshoppers. The greatest damage is probably caused by paddy bugs, but the worst individual pest is frequently a stem borer or an army worm. The importance of a paddy pest, however, is frequently only local, while many pests attack only sporadically so that an insignificant one may suddenly become important, or an injurious insect may disappear.

Traditional methods of combating insect pests usually give incomplete protection and these methods are rapidly giving way to the employment of new and potent insecticides which, in large-scale mechanised cultivation, may be applied from an aeroplane. The incidence of many pests may be controlled by water manipulation—necessarily it can only be used where drainage and irrigation facilities make this possible.

Loss of crop due to diseases is often overlooked or considered negligible, although paddy is liable to many diseases, any one of which may suddenly become serious. Diseases such as ' brusone,' blast, brown leaf spot, ' ufra,' seedling blight and dwarf diseases have from time to time occasioned great damage. Knowledge of diseases and early diagnosis may obviate preventable loss, while in the early treatment of disease and in its prevention improved cultural methods and better water control will be found to be of paramount importance.

Cultivation

Small areas of land and areas where the divisions of the field are small do not readily lend themselves to improved methods of cultivation. Where, however, large areas of flat land are developed, not only does mechanisation become possible, but crop rotation systems can be adopted. The rotation of paddy with other crops implies an adequate control of water and drainage throughout the year. Such control is obtained in Spain, Italy and New South Wales where the rotation of paddy with temporary pasture and dry-land crops is successfully operated and the yields of paddy are high. In the United States, where water control is good, somewhat similar systems have also found favour.

The systems of cultivation devised by the Asian cultivator as a result of generations of experience are usually sound, and suited to the particular problems of individual areas; mechanised cultivation is unlikely to improve materially on these methods or to result in higher yields. They will, however, economise labour, and enable the work to be completed more speedily, thus enabling advantage to be taken of favourable weather conditions. Mechanisation will also make possible the development of larger areas of land in sparsely populated regions. The density of population in many Asian countries results in cheap labour; in such cases labour cost is not regarded seriously by the paddy cultivator. The industrial development of such countries leads to the provision of alternative sources of employment and the neglect of traditional paddy planting. In such instances the grower comes to consider paddy planting from an economic standpoint and he may conclude that only under mechanised cultivation can it be retained.

Dry-land paddy

Paddy is a dry-land plant and despite the fact that originally it was cultivated under dry conditions, non-irrigated or ' dry ' paddy appears to have received less attention than it deserves both from cultivators and investigators of the rice industry.

Undoubtedly, vast areas of swamp land await development for wet paddy, but it may well be found that the cost of reclamation of much of this land is excessive while areas elsewhere may be suitable for development for dry paddy at a much lower cost. The conservation of water for the cultivation of dry-land paddy would in many areas of low rainfall enable dry-land paddy to be grown profitably, whereas this water supply might prove inadequate or too costly for growing wet paddy.

There are a large number of varieties of dry-land paddy. Hitherto, research work towards the improvement of these has been neglected in favour of the selection and breeding of the wet-land types. There is no doubt that had the same degree of attention been given to the dry-land varieties as has been given to the wet types, the results would have placed dry-land paddy cultivation in a more favourable position than it occupies at present.

Manuring

The general experience concerning the use of fertilisers on paddy land has resulted in the accumulation of considerable experience on the manuring of the crop under different climatic and other conditions with varying amounts of nitrogen, phosphorus and potash, but with a very incomplete knowledge of the nutritional requirements of the crop. Knowledge of trace elements in relation to paddy growth is also incomplete although there is reason to believe

D.4 tractor towing the Pacific Terracer constructing contour

that they play an important part at all stages of development of the plant.

In most countries the paddy crop responds to fertilisers in which nitrogen is present in the form of ammonium compounds. In many soils the limiting factor to yield is phosphorus, but potash is not, as a rule, required. The response to manuring is usually more marked on the lighter types of soil than on the heavy clays. Response to manuring with artificials, however, varies considerably, pointing to the necessity for further study of the problem.

The general trend of manurial experiments has emphasised the importance of organic matter, either alone or more often in conjunction with artificials. Full advantage should be taken of any ready means of increasing the organic matter in the soil, and of applying fertilisers in addition to, and not instead of, organic matter. In this way the reduced cost per acre may be within the means of the peasant cultivator.

The time and method of application of both organic and inorganic manures may well be a factor of first importance in the manuring of paddy. Following recent research work in Great Britain on the oxidation-reduction zones in waterlogged soils, the Japanese consider that the loss of ammonia and nitrogen through oxidation-reduction in paddy soils can be largely prevented if nitrogenous fertilisers are thoroughly mixed with the soil and the field irrigated within three to four days after application of the fertiliser.

Storage

Faulty storage is the cause of much damage to grain through insect and fungoid attack. Clean, high quality grain is less subject to attack by fungi than broken or injured grain, for the food material of damaged grain is more readily available for the fungi and absorbs moisture more readily than unbroken grain. The prevention of high moisture content is the best means of protecting grain against fungus and insect attack. Modern storage methods aim at the control of moisture, and there is now a wide choice of insecticides for the rapid destruction of insect pests.

Nutritional value of rice

The composition of rice differs with the variety, according to the soil in which it is grown, and with manuring. But the losses of nutrients in milling, storage and cooking so far outweigh in importance any advantage that might accrue by increasing the nutrients in the varieties as to render this line of research unimportant.

The fat content of rice is low and much of it is lost in milling. The protein of milled rice is low in comparison with other cereals. Rice compares favourably with other cereals in the amino-acid content, and the digestibility of the proteins is high. Fat-soluble vitamins are negligible, but vitamin E is considerable. Husked rice has a high content of vitamin B; the riboflavin content is low and vitamin C practically absent. The low content of lysin is the most serious amino-acid deficiency. The average amounts of vitamins of the B complex are of the order 4 microgrammes of thiamine, 0.6 microgrammes riboflavin and 50 microgrammes of niacine per gramme. Pantothenic acid and pyridoxine, two further vitamins of the B complex, are also found in rice. The amounts of thiamine, riboflavin and niacine present in rice differs between varieties, while the thiamine and riboflavin content is also influenced by geographical location.

Recent work on the distribution of vitamins in the rice grain has shown that a high proportion of the vitamin B is contained in the scutellum and aleurone layer. It follows that milling should be designed to remove the pericarp but retain the scutellum and as much of the aneurone layer as possible. Unfortunately, however, the demand for white rice results in over-milling and thus the removal of the bulk of the vitamins. Further losses of vitamins result from the customary methods of washing and cooking rice.

Many deficiency diseases, including beri-beri, result from eating highly polished rice. Research has clearly demonstrated the anti-beri-beri properties of undermilled rice, while a diet including the ' polishings' obtained in the process of milling will effect a cure of the disease provided that it is not in an advanced stage.

The process of parboiling before milling results in the retention of much of the vitamin B_1 in the grain and is therefore recommended instead of milling white rice. New parboiling processes have been commercialised whereby the resultant rice contains a high proportion of the vitamins, while in other processes milled white rice is artificially enriched by the addition of vitamins.

The possibility of raising yields

The paddy plant yields its maximum crop under sub-tropical and warm temperate climates. Although paddy grown in the tropics may be incapable of attaining these high yields, in most countries of production the yield falls very short of the optimum that should be possible under these environmental conditions. Higher yields would result from the planting of improved seed, better cultural methods and the judicious use of manures and fertilisers. More effective control of pest and diseases, both in the field and store, would save an enormous amount of grain which at present is lost. Improved drainage and irrigation—the effective control of the water at all stages in the growth of the plant—is perhaps the most important factor for increased production. It appears possible that the production of paddy from existing areas might in the aggregate be doubled. Such an increase would not only settle the problem of finding enough rice to satisfy world demand for some years to come, but would vastly improve the economic position of the rice-producing industry.

Photos: P. 360, Dept. of Public Relations, Malaya; p. 361, Royal Netherlands Embassy; p. 362, Dept. of Agriculture, Malaya.

Rice Production in the United States

E. O. ADAIR

Rice production in the United States has developed to a phenomenal extent during the past fifty years, and progress has been especially marked during and since the last world war, when shortages of rice consequent on Japanese aggression in the Far East have stimulated the production of rice by modern agricultural methods in the United States.

THE story of rice cultivation in the United States began almost three centuries ago when the captain of a ship from Madagascar landed in America and gave a young doctor a peck of seed rice. This doctor planted the seed in the south-eastern coastal area of the United States and harvested an abundant crop. He distributed seed among his friends for further planting and the industry flourished to such an extent that by 1690 planters were using rice to pay quit rents, while by 1700 the Collector of Customs is reported to have declared that there were not enough ships in Charles Town (now Charleston, South Carolina) to export it all.

For over 200 years the rice crop of the United States was produced largely on delta lands of the South Atlantic States, including South Carolina, North Carolina and Georgia. The American Civil War adversely affected the production of rice in that area, but following this there was a rapid increase in the acreage under rice along the Mississippi River in Louisiana, and by 1887 Lousiana had become, and remained until last year, the leading rice producing state in America.

Arkansas and Texas soon joined the ranks of the rice growing regions and in 1912 the crop commenced to be grown commercially in California in the Sacramento Valley. In 1948, irrigated rice was first grown in the Delta of Mississippi and that State is now an important producer. Small acreages are also grown in the Everglade region of Florida and in Missouri.

In 1953, the rice crop in the United States occupied 2,460,000 acres and produced 5.3 million pounds of rough rice. The average acreage under rice for the period in 1941-50 was 1,569,000 acres with an average annual production of 3.3 million pounds of rough rice. Thus production in the United States has increased by about 80% during the past 12 years.

Conditions suitable for rice growing

Though rice is grown in widely scattered areas, certain conditions are necessary for a satisfactory crop. These are (*a*) high temperatures, especially high mean temperatures, during the growing season; (*b*) a dependable supply of fresh water for irrigation; (*c*) soils that are comparatively level and hold water well; and (*d*) good surface drainage. These conditions are found on the coastal plains of south-western Louisiana and south-eastern Texas and on the Grand Prairies and other sections of eastern Arkansas. Here the summers are warm with temperatures ranging from 90° to 100°F., while the average rainfall ranges from 50 to 57 in. and is well distributed during the growing season.

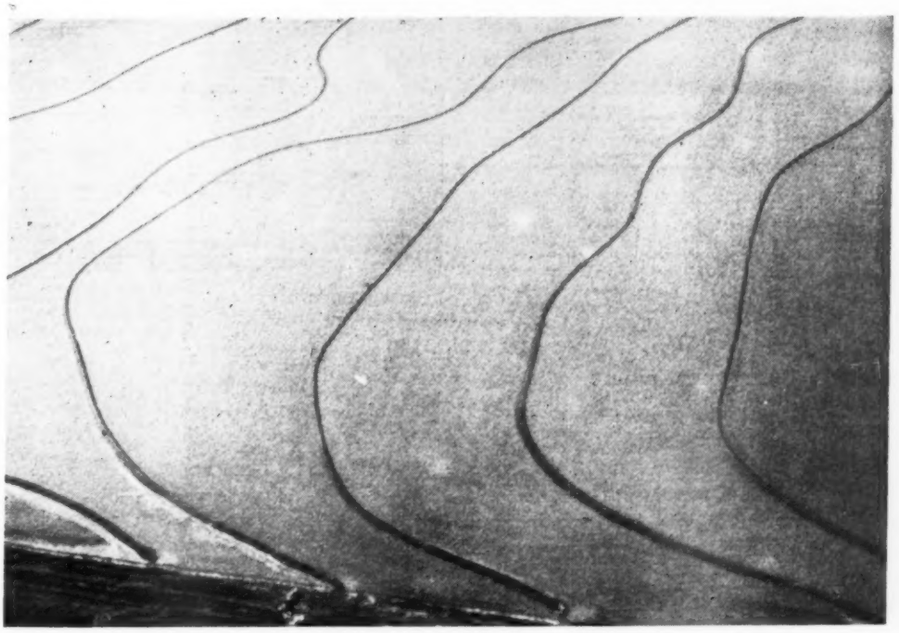
In the Sacramento and San Joaquin Valleys in California the summers are hot with low humidity. During June, July, and August, maximum temperatures range from 105° to 115°F.: however, the nights are comparatively cool. The clay and clay-adobe soils of California have an impervious subsoil at a depth of 1½ to 6 ft. below the surface and ample water is available from the mountain streams and reservoirs.

Varieties of rice grown

In the commercial rice-producing areas only the wet or irrigated varieties are grown. They include short-, medium- and long-grain types. At maturity the plants vary in height from 36 to 58 in. The average length of the hulled kernel of the short-grain type is 5.5 mm., that of the medium, 6.6, and that of the long-grain 7 to 8 mm. These are further divided into early, mid-season and late maturing classes.

In the southern region, which includes Arkansas, Texas, Louisiana, and Mississippi, less than 1% of the rice is of the short-grained type. In California, on the other hand, the short-grain types are are grown almost exclusively. Caloro is the most important. The popularity of this variety results from its wide adaptability, its consistently high yields and its good milling qualities. Another desirable characteristic is its ability to shorten its growing period when planted late. Other short-grained varieties are Cody, Colusa, and Asahi.

The principal medium-grained varieties are Zenith, Arkrose, Kamrose, Magnolia, and Calrose. In 1951, 34.9% of all rice produced in the southern region was of this type, but in California it comprised only 8.1% of the production. Zenith, Magnolia, Arkrose and Kamrose varieties all yield and mill well and are popular with both growers and millers. In general,



Aerial view of contour levees

medium-grained varieties are well adapted to combining but are more difficult to dry than long-grain types.

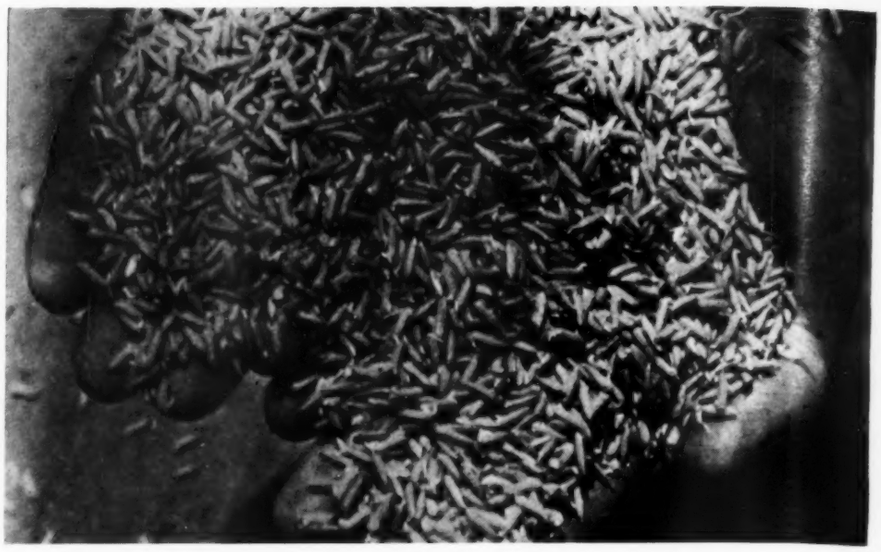
In recent years, the long-grained types have predominated in the southern States. The leading varieties of this type in order of importance are: Bluebonnet, Century Patna 231, Rexore, and Texas Patna. Others of less importance are Rexark and Sunbonnet. Because of the shape of the kernels, long grain rices are more likely to be broken in milling than the short, and medium-grained varieties. However, American consumers prefer the long-grained type since they retain their shape when cooked, and this type commands higher prices for both rough and milled rice. This and the fact that they are more easily combined and dried have caused a marked increase in acreage under long-grained rice.

Two or three other varieties that differ in their date of maturity and grain types are also grown by individual farmers, the reason being that they enable the harvest to be extended over a longer period, which results in more efficient use of labour, harvesting equipment, driers; while the early rice harvested can be sold to help finance the harvesting of the later varieties; moreover, rice of different grain types will be available for sale, which enables growers to take advantage of premium prices for different types should they occur.

The leading rice varieties have been developed in recent years. At present, rice improvement work is being conducted by the United States Department of Agriculture's Agricultural Research Service, Field Crops Branch, and Cereal Crop Section in co-operation with the Agricultural Experiment Stations in Arkansas, California, Louisiana and Texas, the Texas Rice Improvement Association and the California Co-operative Rice Research Foundation, Inc. Field experiments are conducted at the Rice Experiment Stations at Stuttgart, Arkansas, and Crowley, Louisiana, as well as at the Texas Agricultural Substation No. 4, Beaumont, Texas; and at Biggs Rice Field Station, Biggs, California.

Rice breeding programme

The rice breeding programme is approached from three angles: (*a*) the introduction of varieties from foreign countries, (*b*) the isolation of pure line selections from commercial and introduced varieties, and (*c*) the creation of new varieties by crossing followed by selection. Among the best selections, we have Colusa, an early maturing variety, Caloro, early to mid-season, Asahi, a mid-season short-grain, Zenith, medium-grain, and Rexora, a long-grain type.



Germinated seed ready for seeding by airplane

Hybridisation was started in 1922 by the late J. W. Jones at Biggs, California. Now, this method is being used in rice improvement work in each of the rice producing States and is giving good results. Varieties that have been developed by this method are Cody, Arkrose, Kamrose, Magnolia, Bluebonnet, Century Patna 231, Texas Patna, Rexark and Sunbonnet.

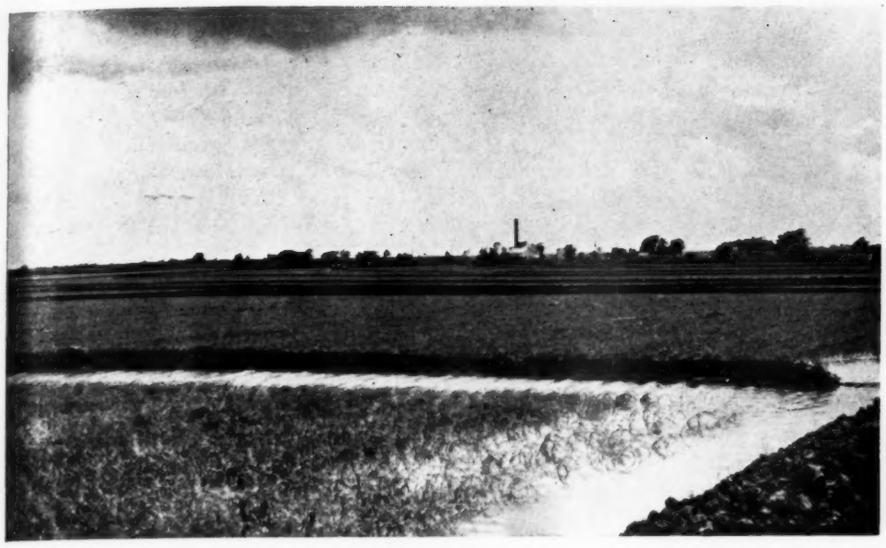
The principal objects of the breeding programme are to develop early, mid-season and late-maturing varieties with short-, medium- and long-grain types that have a wide range of adaptation and include the following characteristics:

1. Seedling vigour and hardiness.
2. Free tillering.
3. Resistance to the more serious diseases.
4. Uniform maturity.
5. Short stiff straw.
6. Combine satisfactorily.
7. Easy drying.
8. Smooth hulls.
9. Salt and alkaline tolerance.
10. High yields.
11. Good milling quality.
12. Satisfactory cooking qualities.

Seedbed preparation

Rice is usually grown on lands that are comparatively level with a gentle slope toward drainage ditches. Growers usually employ surveyors to locate canals, drainage ditches and field levees. The levees are located on contour lines on a 2-ft. dif-

Seeding rice in water



Watering young rice

ference in elevation. In California, they use tractor-drawn steel or wooden dikers to construct levees; in Texas and Louisiana double pushers and, to some extent, steel pushers on wheels; in Arkansas, levee discs and pusher type implements. In the Southern States the levees are built with sloping sides to obviate damaging machinery and to reduce the cost of seedbed preparation, seeding and harvesting. Levees of this type are themselves seeded and produce considerable rice, thereby reducing the growth of weeds. In California, the levees are larger, but are not seeded to rice nor crossed over in harvesting. Metal or wooden gates are installed in them to regulate and maintain water level.

In preparing the seedbed, farmers plough the land 4 to 6 in. deep in the fall or spring, depending on the locality and weather conditions. Ploughing is followed by discing, harrowing and flooding until the surface soil is reduced to a mellow condition. Lately, land levelling with land planes and other levellers has become a common practice. This reduces the number of levees, and puts the land in better condition for irrigation and surface drainage, resulting in more uniform plant growth and maturity, and facilitating harvesting operations. In a good seedbed, germination usually occurs promptly without flushing with water.

Planting the crop

The rice crop is propagated by seed sown direct in the field. Transplanting is nowhere practised.

Rice is generally seeded in April or May. Under favourable weather conditions, however, some seeding is done in March or June but most rice is planted between April 15 and May 10. Farmers spread the seeding dates of some varieties so that the harvest can be extended over a longer period. The rate depends on such factors as the size and quality of the seed, the condition of the seedbed, the variety planted, and the fertility of the soil. Ordinarily 90 to 100 lb. of good seed per acre is enough to give satisfactory stands.

Seeding is done either with a drill on a dry seedbed or by airplane on flooded fields. The latter method is more used in California than in the Southern States. When seeded by airplane, the seed is presoaked for 36 to 48 hours and then allowed to drain for 12 to 24 hours before seeding. This method usually gives uniform stands of rice.

Irrigation

The land is submerged to a depth of 1 or 2 in. when the drilled rice seedlings reach a height of 4 to 6 in. The depth of water is gradually increased, as the seedlings reach 4 to 6 in. and is maintained at that depth for 60 to 90 days or more during the growing season. The water is often drained to control root maggots and to prevent 'straighthead.' Besides supplying the necessary moisture for growth, water also helps to control weeds and serves as a temperature regulator thereby maintaining a more uniform temperature for plant growth.

Water for irrigation is obtained from wells, streams, or reservoirs. The amount per acre depends on soil type and humidity. In the Southern States, growers count on using from $2\frac{1}{2}$ to $2\frac{3}{4}$ acre-ft. whereas, in California, 4 to 8 acre-ft. are required to produce a crop. Insufficient water results in poorly developed plants with small panicles and low yields of poor quality. Plenty of water is essential for a profitable crop.

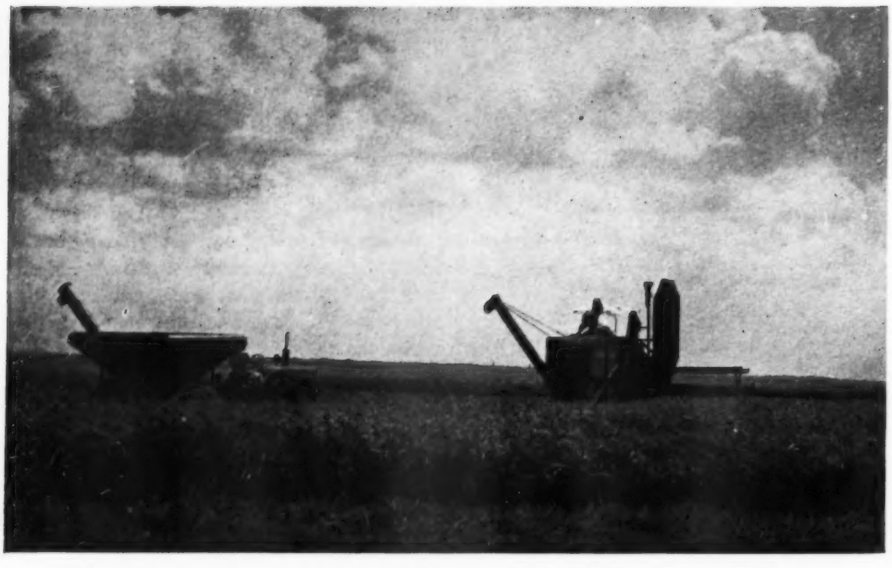
Fertilisers

The use of fertilisers is a common practice in rice culture in the United States. Scientific experiments show that the plant-food elements most likely to be deficient are nitrogen and phosphorus, but occasionally response is obtained from potash. Of these elements, nitrogen is the most important. Because of the wide variations in soil fertility, growers are advised to have their soil tested as a guide to proper fertilisation. Field tests show that the method and timing of fertiliser applications are important in getting the best results. Applications of nitrogen make for vigorous plant growth and under some conditions hasten heading and ripening. However, heavy applications may cause lodging, increased sterility, and susceptibility to diseases.

Ammonium sulphate, cyanamid, urea, and anhydrous ammonium, as well as ammonium nitrate, have been used with advantage. The rate varies with the fertility of the soil. Requirements in the Southern States vary from 40 to 80 lb. of nitrogen per acre. It is applied at seeding time when sown in the water or just before irrigation when rice is drilled. In California, on average soil, they use 150 lb. of ammonium sulphate per acre. Top dressing after seeding is done by airplane. The use of anhydrous ammonia is not a common practice but it gives good increases where nitrogen is necessary and its use is increasing. Of all fertilisers tested, ammonium sulphate gives the best results. Applications of phosphate are essential for maximum yields on some soils in the Southern States. Rarely does potash increase yields but under some conditions it lessens the damage by stemrot. To insure high yields, progressive growers not only use commercial fertiliser but try to maintain a good supply of organic matter by crop rotation.

Rotations

Rice is not continually grown on the same land. In Louisiana and Texas, common practice is to grow one or two crops of rice, then lay down the land to grass from one to three years before using it again for rice. In Arkansas, oats, lespedeza, and soya beans are grown in rotation with rice and harvested with the same equipment. In California, a common practice is to alternate a rice crop and fallow, followed by fall-sown wheat or barley. A rotation system is more difficult to follow with rice than with other cereal crops.



Rice harvest scene showing self-propelled combine and seed cart

Weed control

Weeds create a problem for rice growers in the United States. Because of favourable conditions, water-loving weeds possess abnormal vigour and produce an abundance of potent seed. The most troublesome ones are red rice, barnyard grass (*Echinochloa* spp), coffee bean (*Sesbania macrocarpa*), indigo (*Aeschynomene virginica*), and the sedges (*Cyperus*, spp.). Red rice is controlled by rotating rice with other crops and using ' white ' seed. Barnyard grass can be controlled by seeding in water. The broad leaf weeds and sedges are controlled by spraying with 2,4-D. The amount used depends upon the age of seedlings when treated. Sodium or amino salts are usually used instead of other formulations which are more dangerous to use near susceptible crops. The recommended amount varies from $\frac{1}{4}$ to $1\frac{1}{4}$ lb. per acre. Sowing weed-free seed, following good cultural methods, and eternal vigilance are necessary to prevent, control and eradicate weeds in rice fields.

Diseases

Losses caused by rice diseases are not great in the United States. However, diseases sometimes cause serious losses in some fields. Those of economic importance are seedling blight, stem rot, brown and narrow brown leaf spots, straighthead and white tip. Seedling blight can be controlled by the use of fungicides, such as Arasan, Ceresan M, Spergon, Agrox and yellow cupricide. Some diseases can be controlled by cultural practices and the use of resistant varieties.

White tip, caused by nematodes, is the most serious menace among the diseases that attack rice. The nematodes or eel worms winter in the dormant state between the hull and kernel in seed. Since the disease is seed-borne, seed treatment is the best means of controlling it. In searching for control, many compounds were tested. The nematocide, N-244, has given best results. When used at the rate of 4 oz. per bushel, 10% formulation, N-244 controls white tip and increases yields. This chemical does not retard growth of the seedlings and is safe to use. Varieties differ in their reaction to the nematode that causes white tip. The most resistant varieties are Arkansas Fortuna, Nira 43, Bluebonnet, Century 231 and Century 52.

Harvesting the crop

Remarkable progress has been made in the methods of harvesting rice. Since 1948, most of the crop has been harvested with either self-propelled or tractor-drawn combines. These range in size from 6 to 14 ft. cut in the Southern region and from 6 to 21 in California. The use of the self-propelled combine reduces the labour requirement for harvesting rice to about one-fourth of the amount necessary with the binder-thresher.

The combined rice is elevated into a bin or hopper on the combine and then transferred to a tractor-drawn rice cart equipped with an elevating device. The grain is then hauled to the drier. When harvested the grain contains about 20% to 25% moisture which is reduced to 13% or 14% in the drier. Most of the drying is done off the farm. The rice is stored in bulk in elevators. Seed rice is sometimes sacked and stored in warehouses. Well-grown rice, drained and harvested at the right time, and dried properly assures a high quality product.

Conclusion

Since the early days, the rice industry in the United States has not only shown phenomenal expansion in acreage but also remarkable progress in all phases of production and harvesting. Today it is one of the most efficient and highly mechanised sections of agriculture in the country.

Empire Cotton Growing Corporation

The annual general meeting of the corporation was held in Manchester on Friday, July 9, 1954, the chair being taken by Lord Derby.

The President of the Board of Trade sent a message expressing his appreciation of the valuable work carried out by the corporation. He pointed out that the continuous efforts devoted to research and experimentation had contributed largely to the increase in production which had taken place in the last few years. The quality of Commonwealth cottons had steadily improved and he was confident that they would continue to find a ready market in Lancashire on their own merits.

Lord Derby, in his review of the corporation's activities, drew attention to the average of a million bales produced over the last three seasons, an increase of 75% over the average for the three seasons immediately after the war. He mentioned that plans were on foot for increased participation by the corporation in cotton research in Aden, Central Africa and Nigeria and, commenting on the annual report, he pointed out that the increased use of Empire cotton in the United Kingdom had gone hand in hand with increased exports to British East and West Africa. It seemed, therefore, to be in Lancashire's interests to use as much Empire cotton as possible.

Mr. James Littlewood, chairman of the administrative council, in discussing his recent tour of Africa, said that the agreement under which the corporation carry out cotton breeding work for the Sudan Government had been renewed for five years, subject to review as necessary, and he hoped that, in view of the great importance to this country of the long staple cotton of the Sudan, the staff would be able to continue their work in that country for a number of years. Much progress had been made towards one of the objects for which the corporation was formed, namely, to lessen dependence on supplies from the U.S.A., and it was the earnest desire of the corporation that there should be no falling off in the amount of Empire cotton coming to the United Kingdom.

Rice in British Guiana

D. H. GRIST

Rice growing in British Guiana started as a small peasant industry, carried on by Indian and Chinese labourers on the wastelands of sugar estates. Today it is a very considerable undertaking, which will, it is expected, supply the needs for rice of the neighbouring territories in the Caribbean as well as all local demands. The author of this article, Mr. D. H. Grist, visited British Guiana not long ago as a member of a study group of the Colonial Development Corporation.

THE paddy lands of British Guiana are confined to the coastal plain, which extends for some 250 miles of Atlantic coast, and inland for not more than 10 to 15 miles. As the surface of this plain is below high-tide level, protection from the sea is necessary, otherwise the whole plain would revert to swamp. This protection is provided by a sea wall. There are occasional sandy reefs elevated a few feet above the general level of the plain—probably old sea beaches—and small natural drainage depressions, known as 'creek hands'; otherwise the maximum difference in land level throughout the coastal plain is only a few feet, gradients of 6 inches per mile being normal.

This coastal area comprises only about 4% of the total area of the colony, and within this restricted area live 94% of the population. The two main crops grown are sugar and paddy, but whereas the sugar industry appears to be static, the production of rice has steadily increased during the past few years, and if present plans materialise, the area under this crop will expand considerably in the next decade or so. The main obstacle to development is the great initial expense for drainage and irrigation, but without this water control, development is virtually impossible. Little, however is, known regarding the suitability of the undeveloped land for agriculture, especially as regards the extent and depth of peat areas, which are common in the undeveloped regions.

The colony is divided into three counties: Berbice from the Courantyne River to Abary Creek, Demerara from Abary Creek to Boerasirie Creek, and Essequibo from the Boerasirie Creek to the Venezuela frontier, at the line of the Pomeroon River.

The mean annual rainfall in the coastal area is between 80 and 120 inches: in Berbice about 80 inches, in Essequibo 100 inches, and in Demerara 120 inches. There are two rainy seasons: a very dependable mid-year rainy season from May to July, and a very uncertain one both as to time, duration and amount of rain from mid-November to mid-February.

Water control

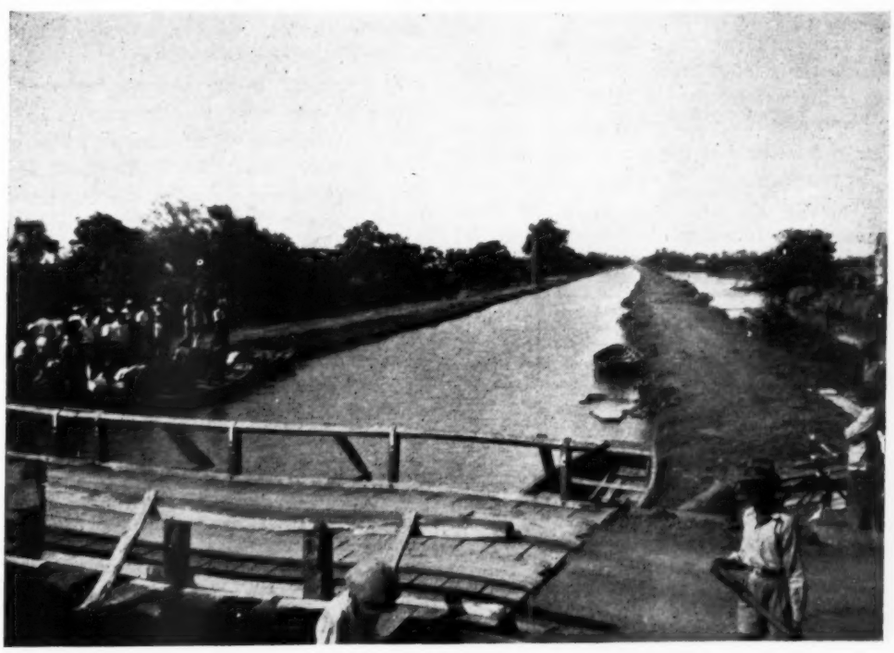
The view has been expressed that paddy can be grown in British Guiana without the aid of drainage and irrigation, but while this is true in favourable seasons, dependence on ideal conditions inevitably leads to considerable losses in years of drought or of exceptionally heavy rainfall.

Hitherto, the system of empoldering has been adopted for the control of water. By this method an area is enclosed by dykes and is provided with irrigation channels, known as 'middle walks,' and drainage or 'side line' channels. Empoldering is stated to be an easy and comparatively cheap method of water control, but expert opinion holds that it may lead to grave trouble, due to enforced restriction of flood water, resulting in floods reaching a high level and causing breaching of the dykes in years of high rainfall.

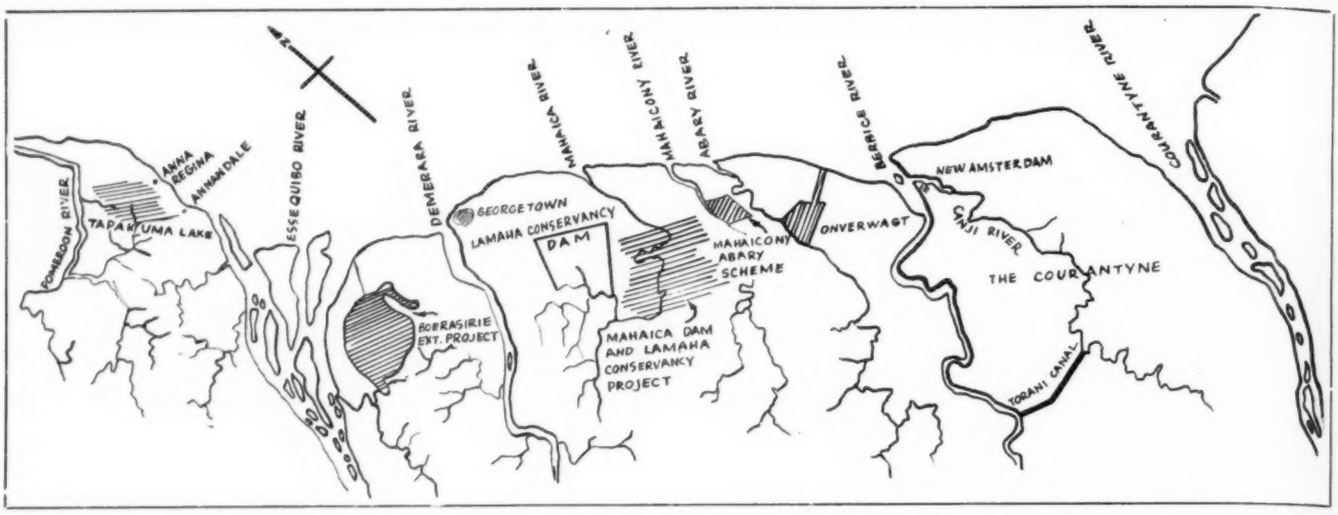
As much of the present area planted to paddy is abandoned sugar cane land, the system of water control devised for that crop has perforce been adopted for paddy growing. This symmetrical layout, although convenient in many respects, does not necessarily result in perfect conditions for paddy. In particular, the natural drainage lines—known as 'creek hands'—are ignored, whereas many of them might have been used as drainage lines. Many of these were probably unsuspected; they are, however, very obvious from the air.

Soils

Most of the paddy land consists of heavy silty clays relatively high in organic matter. The riverside silt soils are recognised as eminently suitable for paddy; in many places one sees a strip of paddy land extending back from both sides of a river bank to areas of swamp where peat depth precludes cultivation. Further in



A 'middle walk' or irrigation canal in the Courantyne



Sketch map of the coastal area of British Guiana showing approximate positions of development schemes

land the soils consist of coarse permeable quartz sand which allows excess rainfall to filter through to lower levels.

Cropping systems

Two crops of paddy are produced annually from much of the land devoted to this crop. The main crop is planted in April and May and is harvested in September and October, thus taking advantage of the dependable mid-year rains. The second crop is planted in November and December, and is harvested in March and April.

Until recent years it was usual to cultivate paddy by the traditional methods used in Asia, the land being ploughed and harrowed, using primitive bullock-drawn implements, the seed being sown in a nursery and seedlings later transplanted in the inundated fields. By this method very high yields are obtained. It is employed for the cultivation of small areas for the autumn crop; for the spring crop planters usually plough, harrow and broadcast or drill the seed in the field. The crop is harvested with a sickle and the grain trodden out by oxen.

Mechanical cultivation

Operations for mechanised cultivation of the autumn crop under dry-land conditions commence with the burning of the straw from the previous crop as soon as possible after harvest. The land is then ploughed with a polydisc plough, after which disc harrows are used to turn under any growth which appears, and to start breaking up the soil. The number of harrowings depends on the condition of the soil, but two are usual.

The seed is sown by means of a Case seed drill at the rate of 70 lb. per acre, with 6 inches between drills, the seed being placed about 2 inches deep. Alternatively, the seed is broadcast at the same rate and covered with a harrow. The crop is harvested by means of a Case combine, or on small areas with a sickle, and threshed either with a stationary combine or power-driven thresher, or by treading out with oxen.

Where the land cannot be dried for ploughing, a system of underwater cultivation has been evolved. Under this system the land is burnt and ploughed as for dry cultivation. Subsequently it is disc harrowed while the fields are inundated—preferably by about 2 inches of water. The number of discings depends on soil conditions. For the final discing a length of heavy iron pipe is drawn behind the disc harrow. As soon as possible after the final discing and while the mud is still in suspension in the water, the seed is broadcast by hand in the water. The water is then drawn off until germination occurs, after which the field is kept in a flooded condition until two to four weeks before harvest.

The spring crop is grown either from seed broadcast directly after the removal of the autumn crop, in which case the land receives some cultivation, or it is obtained from the seed dropped from the autumn crop. A second crop is also obtainable from rice stubble. If the stubble is not ploughed in or burnt a second crop will spring from the stubble, and if irrigated will be ready to reap within about six weeks. It is estimated that about 16% of the land produces two crops of paddy annually.

Red rice

Red rice, *i.e.* grain with a red instead of a brown kernel coat, detracts from the market value of the product, and causes excessive losses in milling. It is probably the most serious pest of paddy in British Guiana. Paddy with 10% of red rice is considered ' good,' while not infrequently the percentage of red rice is as high as 45%.

In British Guiana red rice almost certainly consists of one or more varieties and numerous crosses of these with white-grained varieties. It causes considerable loss of yield due to its tendency to early shattering in comparison with the main crop, thereby not only decreasing the harvested crop but also infesting the land with seed which will either grow as a drop-seed crop, or may develop with the subsequent planted crop. Control of red rice is possible by changes in present cultural methods. The most effective method of enforcing such improvements would be by price discrimination, a method which has been successfully employed in the United States.

Areas and yields

Rice cultivation in British Guiana was first introduced by the Dutch early in the 18th century, but no effective development of the industry occurred until 1886. In that year rice was successfully grown on a sugar plantation provided with adequate water control, by Indian and Chinese labourers who were familiar with the crop in their own countries. By the end of the century the area under the crop was approximately 7,000 acres; by 1920 it had increased to 58,000 acres, while today over 100,000 acres are annually cultivated with paddy.

The average yield of paddy is 2,460 lb. per acre, of which 1,700 lb. is from the autumn crop and 760 lb. from the spring crop. This yield compares very favourably with other South American countries, the

An example of under-developed swamp land in British Guiana

United States, or with Asian countries. The yield varies quite considerably from year to year, reflecting variations in rainfall, for much of the area is dependent on rainfall in the absence of adequate drainage and irrigation.

Nowhere in British Guiana is it customary to manure the paddy crop. In the absence of drainage much of the paddy land is inundated for many months of the year. Increase in soil fertility is known to follow 'flood fallowing' of sugar lands in British Guiana. This increase in fertility is variously ascribed to increase in the ammonium nitrogen content of the soil equivalent to the application of 2 cwt. of ammonium sulphate per acre, to an improvement in soil texture, and to increased activity of micro-organisms.

The highest yields are obtained when the crop is transplanted. Thus, in the Essequibo area the average yield with transplanted paddy is 2,770 lb. for the autumn crop, plus 1,400 lb. for the spring crop—a total of $1\frac{3}{4}$ tons of paddy per acre per annum. Good crops in this district exceed 2 tons per acre. In the Courantyne area (Berbice), where mechanisation has made considerable headway, but where there are also many small farms that use the transplanting method, the average autumn crop is about 3,000 lb. per acre. In the Demerara district, where much of the land is now cultivated by mechanised means, the average crop is somewhat less.

One cannot but be impressed with the high yields at present obtained in British Guiana. Doubtless, with improved water control, more suitable varieties of paddy and better methods of cultivation, the average yield of the colony will be considerably higher.

The Mahaicony/Abary Rice Development Scheme

In 1942, rice supplies from Asia were cut off on account of the Japanese invasion of Burma. It was therefore desired to develop rice production in the Caribbean region to ensure supplies to this area. In British Guiana it was considered that extended production could only be done by mechanising the industry.

The Mahaicony/Abary Rice Development Scheme for the development of large-scale paddy production in conjunction with the operation of a large mill was therefore started by the Rice Marketing Board in 1942 with the object of working out these problems of mechanised production by developing about 11,000 acres lying between the Mahaicony and the Abary Rivers. The area consists of an area of 4,700 acres, of which 4,400 acres are capable of cultivation, contained within an inner empolder, which is surrounded by an outer empolder containing a total of 11,300 acres. The land between the two empolders, some 6,600 acres, is farmed by private owners and tenants. In 1946 the affairs of the scheme were entrusted to a separate Board, from which time it has been entirely distinct from the Rice Marketing Board.

The site of the farm is by no means ideal. Both rivers are liable to flood, the Abary, in particular, being difficult. The tendency is for the Abary floods to spill towards the Mahaicony River, while the Abary is also at times too low to permit of flow irrigation. The scheme is therefore largely dependent on pumping, a charge which the paddy crop finds difficult to bear.

In 1949, the Government bought Plantation Onverwagt, situated on the right bank of the Abary River, about five miles above the Mahaicony/Abary Rice Development Scheme, with the object of expanding paddy production to ensure a greater flow of paddy to the central mill. The area consists of 6,237 acres, of which 5,237 is in one block, and 1,000 acres a narrow strip connecting this block with the sea. There is at present no adequate drainage and irrigation over the area.

Results of the scheme

Although the scheme cannot claim to have been a financial success, it has justified itself by the introduction of mechanised cultivation of paddy in British Guiana. Pioneer work has been carried out on the scheme in adapting agricultural machinery for the cultivation of paddy, and from the experience gained it has been possible to devise a sequence of operations suitable for average conditions in the colony.

With the exception of the United States and Australia in no country has mechanised paddy production been so widely adopted as in British Guiana; this development took place within a period of five years, and the main credit for it must be given to the Mahaicony/Abary Rice Development Scheme. The scheme popularised mechanisation by operating a hire service of machinery for the mechanical cultivation of the crop. This operated at a loss, but undoubtedly went far in making the rice grower machine conscious, for mechanisation has been adopted in all parts of the coastal region, perhaps with more enthusiasm than discretion. Further investigations are desirable with the object of improving the conditions within which machines work, including the selection of the best machines, and the reduction of the operating costs. The scheme possesses and operates an up-to-date rice mill which has replaced a number of small mills in the vicinity.

Paddy varieties

The number of varieties of paddy grown in the colony is small compared with Asian standards, but fortunately the majority are reasonably good, being mostly long-grained and well filled. Most of them were probably introduced by the Dutch and French, as well as by East Indian and Chinese indentured labourers. The introduction of mechanised harvesting has, however, resulted in a demand for new types having

shorter straw to obviate clogging in the combine, less liable to lodge, and bearing fewer tillers, so that the crop may ripen more evenly. A further objection to present varieties is that they shatter more freely than is desirable. In order to lengthen the harvesting period and so economise the number of combines required, it is desirable to introduce varieties with different maturation periods. All varieties at present used tend to ripen at the same time irrespective of date of planting.

The need in British Guiana is not only for varieties more suitable for mechanised conditions, but for a better policy and organisation for the production and distribution of pure line seed. The methods employed for the production and distribution of pure seed have not been an unqualified success, and the various branches of the industry all appear reluctant to undertake responsibility for this most important service. In view of the rapid deterioration of varieties under the present system of mechanised farming, and the dangers inseparable from the production of two annual crops of paddy, the organisation of this service on a sound basis is of great importance.

Rice milling

In the early days, rice was prepared by primitive methods. The milling industry dates from the time when increased supplies of paddy necessitated the introduction of more modern methods of milling. The larger importing merchants were the first to erect and operate rice mills, but this industry soon passed into the hands of owners of small mills, who not infrequently were also paddy planters. The rice industry in British Guiana is severely handicapped by the large number of inefficient small mills, and the wide variations in extraction and quality which result.

Rice is produced in about 200 mills, all of which prepare parboiled rice, the type in chief demand throughout the West Indies.

Improvement in milling is most important in connection with the expansion of the rice industry. Many of the present mills are impossible of improvement, and this points to the need for concentrating milling in a few large and up-to-date mills, which could economically produce a high-grade product.

The Rice Producers' Association

The Rice Producers' Association is a statutory body established in 1946. Membership is open to landlords and tenants of rice lands, rice farmers and rice manufacturers. It is governed by a council mainly elected through district associations, but eight members are nominated by the Governor to represent producers.

The Rice Marketing Board

Perhaps the most important, and certainly the most efficient organisation in the British Guiana rice industry, is the Rice Marketing Board. The desirability of improving the quality of rice and its efficient marketing does not appear to have been appreciated until 1920 when attempts were made to establish a system of grading rice for the export market. This led, two years later, to the establishment of the Rice Marketing Board, to control the export of rice and to regulate prices. In its early years the board did not function well, but the suspension of its activities in 1939 led to unjustifiable competition between exporters, and in consequence the board was restored at the end of that year.

With the advent of war, the Rice Marketing Board assumed complete control of the rice industry under defence regulations, and control is now maintained by the board under an Ordinance of 1946 amended in 1950.

The functions and powers of the board are wide. It is given general supervision of the disposal of paddy produced in the colony, and the control of the manufacture, purchase, sale, distribution and export of all rice manufactured in the colony. It is the sole authority for the sale of rice in the colony either for sale or export, except for a small allowance to producers, which they are allowed to retain for their own consumption. The board fixes grades and prices both for domestic consumption and for export. In fact, the board exercises complete control over the rice produced in the country. In doing so, it undoubtedly assists the producer and protects him from exploitation by merchants and middlemen.

The board consists of 16 members appointed by the Governor, of whom four are officers in the public service, eight are rice producers, and four others of whom two are members of the Legislative Council. The chairman and vice-chairman of the board are appointed by the Governor from among the 16 members.

The inequality of rice produced in the numerous small mills throughout the country has necessitated bringing all rice to the board's premises in Georgetown for blending into grades suitable for export and for domestic consumption. This has enabled the board to build up a considerable reserve fund, and to acquire and develop an advantageous site at Georgetown which is served by both rail and road, and is equipped for storage and shipping of rice.

The export market

Hitherto, the Rice Marketing Board has experienced little difficulty in marketing the whole of its surplus rice in the East Caribbean, and it is probable that an extended market exists in this region for

Aerial view of coastal land in the Courantyne. The thin white line is an irrigation canal, the thick winding line is a river. The houses line the main—and only—road which runs parallel with the sea for the entire length of the coast. This is a possible site for a large rice mill

additional exports from British Guiana. The possibility also exists for developing an export market with certain non-British territories in and adjacent to the West Indies. It would appear, moreover, that the colony is well placed to take advantage of new market opportunities, should production increase sufficiently.

Water control schemes

From many points of view it is very desirable that more of the coastal plain should be drained and irrigated. Mr. F. H. Hutchinson, C.I.E., M.I.C.E., consulting engineer to the British Guiana Government, has suggested a number of schemes for the control of drainage and irrigation over considerable areas of the coastal plain. He does not favour the further extension of empoldering but advocates that sectional schemes should embrace the whole area between any two major rivers, and considers that flood control of secondary rivers and the holding back of irrigation water should be undertaken as far back from the coast as is practicable. Further, main irrigation and drainage canals should follow as far as possible the low watersheds and shallow natural drainage channels. The rectangular system of the present polders should be avoided and the main drainage canals should be constructed so that they can also be used for transport.

Natural drainage channels are provided by the rivers. Mr. Hutchinson's five schemes are therefore concerned with the five areas between the principal rivers, *viz.* the Tapakuma Project between the Pomeroon and the Essequibo Rivers; the Boerasirie Extension Project between the Essequibo and Demerara Rivers; the Mahaica Dam and Lamaha Conservancy Project between the Demerara and Mahaicony Rivers; the Mahaicony/Abary Project between the Mahaicony and the Berbice Rivers; and the Canji Project between the Berbice and Courantyne Rivers. No detailed account of these proposals can be given here (they have been published in detail in the colony), but they are likely to have a profound influence when put into effect, on the development of coastal agriculture in the colony.

Financing agricultural development

The carrying into effect of these ambitious schemes will take some years and will entail the expenditure of a large sum of money. There is urgent need for the development of the coastal plain for agriculture, for the improvement in transport facilities and for the provision of capital to develop the land when the water is under control. When the plan for coastal development is carried out more than one million acres of fertile land should be available for intensive cultivation, particularly rice. Financial provision has already been made for work on the Boerasirie Project, which will take about five years to complete.

Combining paddy on the Mahaicony/Abary Scheme

In addition, a grant of $BWI 1,019,488 has been made under the Colonial Development Welfare Scheme to complete work on the Torani Canal in the Courantyne drainage and irrigation scheme. This grant is additional to a free grant of $4,144,799 and a loan of $247,560 already provided towards the major scheme in the Courantyne.

The British Guiana Rice Development Co. was formed in 1942 with an authorised capital of $BG 10 million, of which the Colonial Development Corp. provided $BG 5 million. In addition, $BG 2 million is allocated in shares to the Government and the Rice Marketing Board in respect of the assets of the Mahaicony/Abary and Onverwagt Schemes. The company is taking over these two schemes for the cultivation of paddy and will also operate the rice mill at Mahaicony/Abary and will erect and operate rice mills at Anna Regina in the Essequibo, and in the Courantyne area of Berbice.

The Secretary of State for the Colonies announced in February 1954 plans for developments in British Guiana which for the next five years are likely to cost not less than £15 million. He stated that details are being worked out in British Guiana and the report of the International Bank Mission was proving of great help. He added that the Governor of British Guiana had produced detailed proposals for the next two years costing about £9 million. These included rather more than £3 million for transport, communications and other public works to reconstruct and expand roads, railways, ports and telephones. A further £1½ million would be required for agriculture and forestry to carry out research, major drainage and irrigation schemes and land settlement for small farmers, and about £1 million for agricultural and industrial credits to be administered by a credit corporation. An additional £2½ million would be used for social development, including a housing programme of £2 million in addition to expenditure of over £500,000 from sugar funds to carry out certain improvements in that industry.

As a first step, a further grant of £3,125,000 would be made from Colonial Development and Welfare Funds and facilities given for up to £3,417,000 extra loans to be raised as required in London. With the money already available for development this would provide the estimated £9 million required. The Government would decide later how exactly to provide further finance.

Conclusion

It would appear that, provided the work is not slowed down by shortages of material, skilled staff and artisans, the projects for the improvement of agriculture in British Guiana should be brought to fruition within a reasonable time, and the great untapped source of wealth which at present lies under water in the coastal plain of British Guiana may be developed for the betterment of her people.

The Possibility of Producing Rice for Export in Australia

PETER KNOX

Articles on rice growing in Australia have already appeared in WORLD CROPS *on several occasions. Of recent years much interest has risen in the possibility of producing rice for export in the Northern Territories and also in Western Australia, in addition to the already substantial production in the Murrumbidgee area. The limitations and possibilities are discussed below.*

THE highly mechanised Murrumbidgee Irrigation Area of New South Wales, Australia, produces more than enough rice for her own needs. Now she is examining the possibility of producing an even greater surplus which can be of value to other countries. The main hope lies in the Northern Territory. This vast area (523,000 square miles) has long lain empty. It is a savage land of searing droughts and destructive floods, of fierce jungle and desert. To turn it into a productive rice-growing area will be a tremendous task.

Historical

Rice growing in the territory has a history studded with setbacks and false starts. More than 50 years ago Chinese working in the gold mines at Pine Creek, 60 miles from Darwin, cultivated rice for their own use. But their effort was short-lived; the gold petered out and with it the Chinese and their primitive rice plots.

In 1915, trials with varieties of rice were carried out at Yanco Experimental Farm, New South Wales, under irrigation. These trials were also unsuccessful mainly because of unsuitable seed. In 1924-25, Australia tried again and 157 acres were put under cultivation in the Murrumbidgee Irrigation Area. Success followed this attempt and production expanded rapidly. In 1950-51, 36,945 acres produced 76,500 tons of rice worth £A2,171,000. With an average yield of better than two tons an acre, the area is one of the highest yielding in the world.

Further trials in the north

With this triumph behind her, Australia has now turned again to the north in an effort to expand her rice production. Renewed interest in the matter occurred in the early post-war years, following the disastrous famines in South-East Asia, when Australia was going without rice to enable it to be exported to help neighbouring countries.

Scientists of the Commonwealth Scientific and Industrial Research Organisation began preliminary investigations into the rice-growing possibilities of the territory in 1945. The territory has hundreds of thousands of acres of land suitable for rice, but is liable to drought, floods and fierce heat. The story of rice growing in the next few years was one of disappointment.

Two experimental stations were set up, one on the Ord River in the Kimberley region of Western Australia and the other at Katherine in the Northern Territory, 200 miles south of Darwin. At Katherine they were concerned mainly with cotton, tobacco, peanuts and pasture improvements, but in the Ord River district they turned to rice. The Kimberleys are a region of valleys and mountain ranges which shield rich flats. The research station lies on a fertile stretch on the Ord. Irrigation is supplied by pumping from the river, for the Kimberleys receive only 30 to 40 in. of rain in the November-March monsoon.

Birds and insect pests

In November 1947, the first crop was planted and grew well, but the crop was destroyed by white cockatoos. The same thing occurred next season and by the end of 1949 three out of five rice crops had been destroyed by cockatoos. In addition, small finches and swarms of grasshoppers invaded the area at harvesting time and accounted for much destruction, while marauding kangaroos and wallabies also damaged the crops. Attention is being concentrated on methods to counter these animal pests.

Poggendorff report

In 1950, Mr. W. Poggendorff, chief of the Plant Industry Division of the New South Wales Department of Agriculture, one of the experts responsible for the successful growing of rice in the Murrumbidgee Irrigation Area, visited the region. After a

Difficult country in the Ord River district of the Kimberleys. Engineers have examined the area for suitable sites and have commented favourably on one location. The scheme would probably cost over £A2 million

survey of the territory he concluded that there are areas of natural flood country around Darwin, Wyndham and Derby which contain possibilities for rice growing, but added that before definite pronouncements could be made extensive investigations must be conducted to determine the physical and economic factors involved.

Following this report, the Minister for the Territories, Mr. Paul Hasluck, set up a committee in 1951 to report on the possibilities. The committee recommended two areas for immediate trial in the Katherine-Darwin region and three experimental stations were set up there almost immediately.

Rainfall difficulties

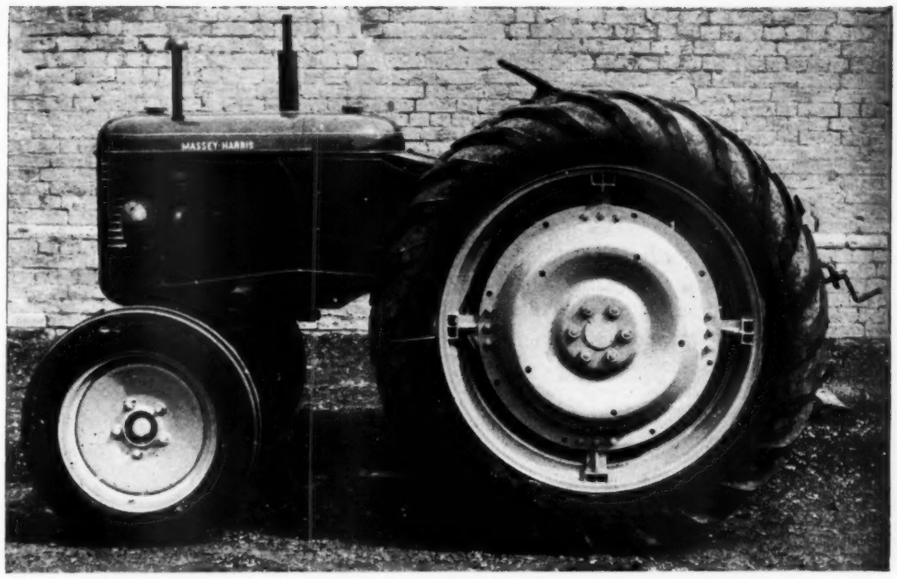
Before the experiments got under way the 1951-52 monsoon blew in at only half-strength. From November 1951 to March 1952 rainfall was disastrously short. Losses occurred all over the territory and some estimates put the stock toll at 500,000 or half the territory's normal beef herds. But the next monsoon blew in on time and in strength in November 1952 and, indeed, later falls were so heavy that part of the rice crop was drowned despite embankments and drainage. Part of the crop was, however, an undoubted success. It grew well on the rich soil, especially the imported South-East Asian varieties, and one plot typical of over 1,500,000 acres of potential rice lands showed great promise.

Conclusion

It has now been proved that rice can be grown in the Northern Territories, but the problem is fundamentally one of agricultural engineering. When Australia can train and use agricultural engineers as effectively as agricultural scientists and cultivators, it can change the face of the north.

Much pioneer work has been done, but vast amounts have yet to be accomplished. The trials are continuing in 1954. Australia has the land (nearly 3,000,000 acres) and the climate and the markets are waiting. To make a success of it she has to conquer drought and flood, desert and dust, pests and diseases. If the goal is reached successfully, nearly 3,000,000 acres of land will be developed to produce close on two tons of rice an acre. This has been done in the Murrumbidgee Irrigation Area. This time it is an immense and cruel task and half the people of the world will watch in anxious hope as Australia carefully prepares her plans to fill the rice bowls of the future.

Article and photograph: Australian News and Information Bureau.



A New Type of Tractor for Work in Rice Fields

The main problem besetting the mechanisation of rice cultivation is to devise a type of tractor which works satisfactorily under the wet conditions prevailing in rice fields and can stand up to the rough usage which may be expected to be encountered. Probably the most urgent problem is the perennial one of the liability of tractors and implements, when used in the partially submerged conditions of rice fields, to become bogged down and immobilised, from which ignominious situation they have to be rescued, usually by being towed out with the assistance of another machine located on adjoining firmer ground.

The traditional attack on the problem hitherto has been to spread the weight of the machine so that the pressure on the wet soil per unit of area is reduced to small dimensions. On this account practice has tended to favour track-laying tractors, which of their nature tend to spread the load. More recently attention has been mainly devoted to devising versions of track layers in which the width of the tractor tracks has been greatly extended laterally, with the idea of minimising to the greatest extent the load per unit area. Machines of this type have been turned out by more than one firm and have met with limited success; one of the difficulties which has attended their use has been that of releasing them, when, as does happen in spite of precautions, they unfortunately become bogged down.

The National Institute of Agricultural Engineering has lately attempted an attack on this problem on new lines, having reverted to the idea that the development of the wheeled tractor, as opposed to the track layer, may possibly provide the cheapest solution of the problem. Previous work on wheels at the institute has suggested that the combination in a tractor of light weight and large-diameter pneumatic tyres might be the best approach and a programme of work to check this has been planned.

They adopted as the basis of their work a very light type of wheeled tractor produced in France by the Massey-Harris-Ferguson Co. and fitted it with wheels carrying 11-38 pneumatic tyres at the rear and 6.00-19 at the front, inflated to low pressure. The rear wheels are carried on a new axle bolted to the tractor and driven by internal gears on the centres from sprockets bolted on in place of the original rear wheels.

The idea is only in embryo and to enable preliminary tests to be made the N.I.A.E. are building a test track to reproduce as nearly as possible the conditions existing in a typical paddy area, on which it is proposed to carry out trials with the tractor.

Correction

With reference to the article 'The Mechanical Clearing of Forest and Scrub Land,' which appeared in our August issue, our attention has been drawn by Dr. J. D. Fryer to the point that the experiments described on page 334 under the heading 'Chemical Arboricides' were carried out in East Africa and not in Sierra Leone.

Pests and Diseases of Crops

Two Important Conferences in England

DURING July 1954 two important conferences were held in London under the auspices of the Commonwealth Agricultural Bureaux dealing with the control of the pests and diseases of cultivated crops. These were the sixth Commonwealth Entomological Conference and the Commonwealth Mycological Conference. The conferences were mainly concerned with the occurrence of pests and diseases in the British Commonwealth and were attended by entomologists and plant pathologists from all parts of the Commonwealth and from numerous research organisations in Great Britain. The two conferences ran consecutively, the mycological conference opening immediately after the entomological conference had concluded its sessions. Each conference lasted for one week, the sessions being held in lecture rooms of the Imperial College of Science in South Kensington. In connection with both conferences a series of visits were arranged to research stations in or near London, such as East Malling, Long Ashton, Rothamsted, etc., at which problems in the control of plant pests are studied. The members of both conferences were entertained by H.M. Government at a supper in Hampton Court Palace on Thursday, July 15, when the British Minister of Agriculture, the Rt. Hon. Sir Thomas Dugdale, Bart., M.P., received and addressed the members.

The entomological conference

This was the sixth of the series of entomological conferences (the first was held in 1920) and was attended by 54 delegates, of which 14 came from the United Kingdom, 10 from the self-governing dominions of the Commonwealth and 28 from the colonial territories. The conference was organised by the Commonwealth Institute of Entomology, of which the Director is Dr. W. J. Hall, C.M.G., M.C. The subjects discussed included: (*a*) recent developments in the use of insecticides on field crops; (*b*) the use of aircraft in distributing insecticides; (*c*) the supply and training of taxonomical entomologists for identifying insects; (*d*) the effect of chemicals on the balance of animal populations; (*e*) the resistance of insects to insecticides; (*f*) the estimation of the real losses from insect pests; (*g*) the control of locusts and grasshoppers; (*h*) pests of stored products; (*i*) problems of forest entomology; (*j*) pests of tropical crops; (*k*) the control of tsetse flies; (*l*) research on termites; and (*m*) the biological control of insect pests.

Of the many papers read, mention may be made of the valuable survey presented by Dr. H. G. H. Kearns, of Long Ashton Experimental Station, of the wide range of insecticides and machinery for their application available at present. Also of the papers by Dr. Yeo, of the Colonial Insecticides Research team in Tanganyika, of the results of aerial spraying for the control of tsetse flies in that territory, and by Dr. R. C. Rainey, Deputy Director of the Desert Locust Surveys in Kenya, on the results of direct aircraft spraying of flying swarms of locusts, which represents a great advance in efficacy as compared with ground treatment.

Estimation of crop losses

The estimation of crop losses from insect attack is a difficult problem which is at present engaging much attention; Dr. I. Thomas, Director of the Plant Pathology Laboratory of the English Ministry of Agriculture, pointed out the difficulties. When crops have formed it may be quite straightforward, but when they are young the problem may be more subtle, for an apparent check may eventually prove beneficial while the importance of an insidious attack may be overlooked. Mr. Q. Geering, of the Uganda Department of Agriculture, illustrated the difficulties by referring to the effect of Lygus attacks on cotton in Uganda, and Mr. A. H. Strickland, also of the Ministry's laboratory, pointed out that losses depend on the density of infestation and discussed methods of estimating this.

In regard to tropical crops, Dr. H. F. Barnes, of Rothamsted Experimental Station discussed the very serious attacks of sorghum midge in different parts of Africa which have lately caused much loss, while Dr. J. Bowden, of the Gold Coast, described the losses recently caused by stem borers on maize and sorghums in that territory.

Dr. W. R. Thompson described and discussed the work of the Commonwealth Institute of Biological Control at Ottawa in Canada, of which he is the Director. It has greatly expanded of late years and now has branches in California and Trinidad.

Dr. G. V. B. Herford, Director of the Pest Infestation Laboratory at Slough, England, discussed the considerable developments in the control of insects attacking stored products. He referred to the use of wettable powders in this connection and the use of gasproof sheets in fumigating large bulks of produce, *e.g.* the groundnut pyramids in Nigeria.

Space does not permit the mention of other papers, but the conference must be agreed to have been an outstanding success.

The mycological conference

The mycological conference was organised by the Commonwealth Mycological Institute, of which the Director is Dr. S. P. Wiltshire. It was attended by 36 delegates, of which eight came from the United Kingdom, nine from the Dominions, nine from colonial governments and four from other sources. In addition, there were a considerable number of visitors.

The subjects discussed included (*a*) legislation against seed-borne diseases; (*b*) losses caused by plant diseases in the Commonwealth; (*c*) cereal rusts and their control; (*d*) eradication of established plant diseases; (*e*) fungicides, including the use of antibiotics and systemic fungicides; (*f*) black pod in cocoa; (*g*) oil palm diseases in Nigeria; and (*h*) blister blight in tea and virus diseases. On all these subjects numerous valuable papers were presented and interesting discussions took place.

Particular interest attached to the discussions on antibiotics and systemic fungicides. Antibiotics can hardly as yet be said to have achieved any great application in disease control, but the use of streptomycin in the control of blast in stone fruits in New Zealand is noteworthy. The same applies to systemic fungicides, although the indications of the sulphonamides in this connection are promising.

Like the entomological congress, the gathering must be accounted to have been highly successful and the publication of the various papers which appeared thereat will be awaited with interest.

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The Cocoa Industry in Nigeria, the British Cameroons and the French Cameroons

Part 3—Cocoa Growing in the French Cameroons

D. H. URQUHART, B.Sc. and G. A. ROSS WOOD, B.Sc.

Cadbury Brothers Ltd.

This is the third part of Messrs. Urquhart's and Ross Wood's article on cocoa growing in West Africa. It deals with the position in the French Cameroons, a region about which very little published information has so far been available. Once more we have to express our indebtedness to Messrs. Cadbury Brothers, Ltd., for permission to publish this valuable article.

THIS trust territory is 170,000 sq. miles in extent and its population is nearly 3 millions. Administrative headquarters are at Yaoundé. Under French administration much progress has been made in developing the country. A network of good roads covers the main agricultural productive area and the rapid progress in agricultural development, including the spectacular expansion of its cocoa industry, can be attributed largely to the system of communications developed with great foresight by the French Administration. There are many fine buildings in the main towns and housing standards generally are good. A large hydro-electric plant has been erected at Edea to supply power to Douala and elsewhere.

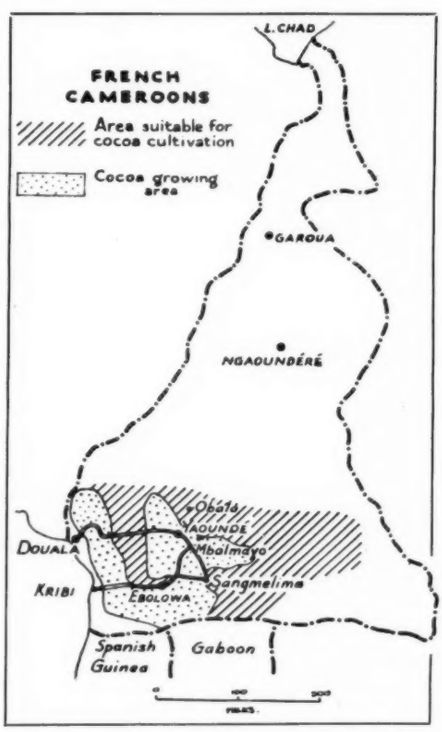
Exports are mainly agricultural products, such as cocoa, which represents half the value of all exports, coffee, bananas, palm kernels and timber. There are few minerals of any value. There are two seaports, Douala and Kribi. At the latter the ships stand out to sea and goods are conveyed to and from the sea-going ships by barges.

Climate

The rainfall in the main cocoa-growing area is 60 to 70 in. and its distribution is similar to that of Tafo. The dry season lasts from mid-November to the end of February and there is a break in the rains during July to August. On the coast the rainfall is much heavier, the rainfall at Douala being well over 100 in. The temperature up-country is cooler than in most cocoa-growing countries. At Sangmelima, for instance, the temperature varies from 64° to 85°F. These lower temperatures are due to the altitude, Sangmelima being at 2,500 ft.

The cocoa industry

In German times planting extended east and north-east of Douala, but this area is wet and humid and there was a high incidence of black pod. Subsequently it was found that cocoa grew well in the region of Mbalmayo, Ebolowa and Sangmelima, south and east of Yaoundé, and north of Yaoundé towards Obala. It is in these regions that the main industry is centred. Most of the cocoa is grown at altitudes of over 2,000 ft. There are extensive areas of good soil in the above regions and much planting has taken place of recent years. Planting is likely to continue as far as it is within the capacity of the available population to extend it.



Map of the French Cameroons, showing cocoa areas

The cocoa trees in the French Cameroons, like those in the British Cameroons, originated from the German plantations. They are Trinitarios; that is, hybrids of various origins. Selections of local types by the staff of the research station indicate that there are cocoa trees of high-yielding capacity. There is little doubt that more extensive surveys will discover more trees capable of bearing heavy crops. The planting industry is in the hands of peasant farmers and the cocoa trees are grown mainly under the shade of forest trees. The exception is to be seen north of Yaoundé and in the region of Obala, where most of the farms are unshaded.

Health of the cocoa trees

The trees growing under forest shade south and south-east of Yaoundé are probably some of the best cocoa trees to be seen in West Africa. Where shade is absent or sparse the condition of leafless twig is present. The less flourishing state of the cocoa north of Yaoundé is possibly due to the prevalence of mists at the higher altitudes. There is higher incidence of black pod and helopeltis attack here than elsewhere.

There is no doubt that the cocoa grows better under shade. If adequate shading can be combined with measures to control black pod, yields should be high.

Area under cocoa and production

It is estimated that there are 120,000 hectares of land under cocoa. Production

from mature cocoa has now reached 52,000 tons. When large areas of cocoa planted within recent years come into bearing, exports will be substantially greater than they are now.

The French authorities have plans in train for stepping up production per hectare from land already under cocoa. It is considered that chemical control of black pod will increase present yields by 30%, that the application of better agricultural techniques will lead to a substantially increased yield and ultimately, it is considered, that, with the use of selected planting material, a yield of 1 ton of dry cocoa per hectare may be expected. The aim is to produce 120,000 tons from the land now under cocoa.

Attention is being given to methods of improving the preparation of cocoa beans. A fermenting and drying house has been designed for co-operative bodies and the farmer who works on a fairly large scale. It consists of a fermenting room where the fermenting boxes are conveniently arranged in tiers. The remainder of the house accommodates the drying trays as required. The trays are slid in and out of the house through an aperture in the wall which is made from ribs of palm fronds. This type of house has the advantage that it provides maximum air circulation for drying the cocoa and also secures the cocoa from theft at night. Another type of drying house which is very popular with the small farmer consists of a mat roof with bamboo runners underneath for sliding the trays in and out, according to the condition of the weather.

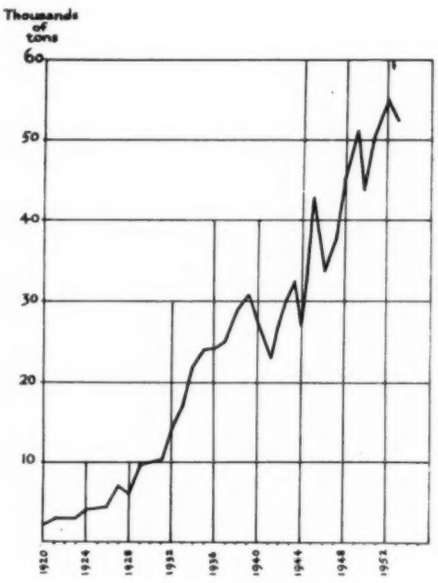
Quality

It has been alleged that cocoa with a smoky flavour has emanated from British and French Cameroons from time to time. Smoky cocoa is anathema to manufacturers, and raw cocoa from both Cameroons has been less popular on world markets than it deserves in view of its good quality generally.

The smoky flavour, where it occurred, was usually attributed to the methods of artificial drying of the fermented beans. Cocoa in French Cameroons is almost entirely sun-dried, so that a smoky flavour could not be acquired in the drying process. An examination of the cocoa preparation and storage in both Cameroons makes it clear that smoky flavour, when acquired, is the result of storing cocoa in the African peasants' dwelling houses, and especially in rooms where meals are cooked. The French authorities discourage the storage of cocoa in dwelling houses and the premium offered for higher grade cocoa, well fermented, has had a considerable influence in improving quality. When prices are high farmers sell their cocoa more readily and there is less tendency to store it; on the other hand, there has been the tendency in the past to under-ferment in time of high prices, as the farmers were in a hurry to sell. It is normal to ferment in boxes for seven days, the mass being turned every second day.

Cocoa tree bearing good crop under forest shade

The quality of the better cocoa is very good; it contains a high proportion of well-fermented beans of good size and free from defects. The quality of the poorer samples is, however, very low, the main defect being mould. Hammy beans have not been entirely eliminated, but the authorities aim to do so.



Cocoa production of the French Cameroons

The grades of cocoa are:

Grade	*Unfermented*	*Other defects*
Supérieur	5%	5%
Courant	10%	10%
		Not more than 5% mould
Limite	20%	15%
		Not more than 5% mould

There is an interesting feature in the method of grading. Purple beans, which are also cheesy, and do not break well, are classified as defects, three of such beans, known as *fèves violettes compactes*, being equivalent to one unfermented bean. Supérieur cocoa is therefore well fermented and of a higher standard than grade 1 cocoa from the Gold Coast or Nigeria. Furthermore, a considerable proportion of the cocoa graded as 'courant' is as well fermented as British West Africa grade 1. There does not appear to be any difficulty about counting these compact purple beans and the fact that each one is counted as one-third of a defect means that any dispute about the assessment of one or two of these beans cannot make a great difference to the final grading. Sub-grade cocoa is not exportable and is sent for extraction of cocoa butter at Douala.

The quality of Cameroons cocoa, as a whole, has varied considerably since the war. It has risen when the Government has kept a strict control of quality at the main cocoa buying markets and when there has been a considerable price differential for the different grades. This differential is determined by competition only, not by the Government. However, neither the differentials nor the Government control have been consistent. Twice—in 1945 and

Cocoa growing well under the shade of mixed forest trees (*left*) and (*right*) heavily-laden tree on a native farm

again in 1950—the Government gave up the control of quality at the buying points and resorted to control at the ports. The following figures indicate the decline in quality in 1950:

	1949	1950
Supérieur ..	0.37%	—
Courant ..	69.56%	11.78%
Limite.. ..	37.91%	78.67%
Déchets ..	12.14%	9.53%

This decline was probably, however, due as much to the higher price and smaller differentials as to the abandonment of quality control up-country.

Government inspection

Government inspection, or 'Conditionnement du Cacao,' has been reinstituted at certain buying stations and a premium for supérieur cocoa has also been started. The payment of the premium is somewhat involved. Any farmer who draws most of his income from his plantation and owns a well-cultivated plantation of 500 trees is provided with a planter's card. When his cocoa is inspected by the Conditionnement du Cacao he presents his card. If his cocoa is of supérieur grade he receives a certificate of quality which entitles him to draw a premium of 6 francs per kilo from the Government. This is approximately equivalent to a differential of £10 per ton. The farmer will, in fact, receive more than this, because supérieur cocoa fetches a higher price from the brokers than either courant or limite.

All cocoa for export is graded and sealed either at port or at certain up-country stations. When cocoa is graded for export each bag is sampled in three places. These samples are bulked in the normal way and 300 beans are cut. After grading the bags are sealed, the seal bearing a letter denoting the place where the cocoa is graded, a number which identifies the grader and one of the letters S, C or L, signifying the grade—supérieur, courant or limite.

Simple drying shed of a type made popular by the administration

Cocoa buying

Cocoa buying in the French Cameroons is similar in set-up to the Gold Coast in pre-war days. A number of firms export cocoa and buy cocoa through middlemen. These middlemen vary considerably in the size of their business, from the man who sets up a weighing scale in a small market to the man who owns a large trading store.

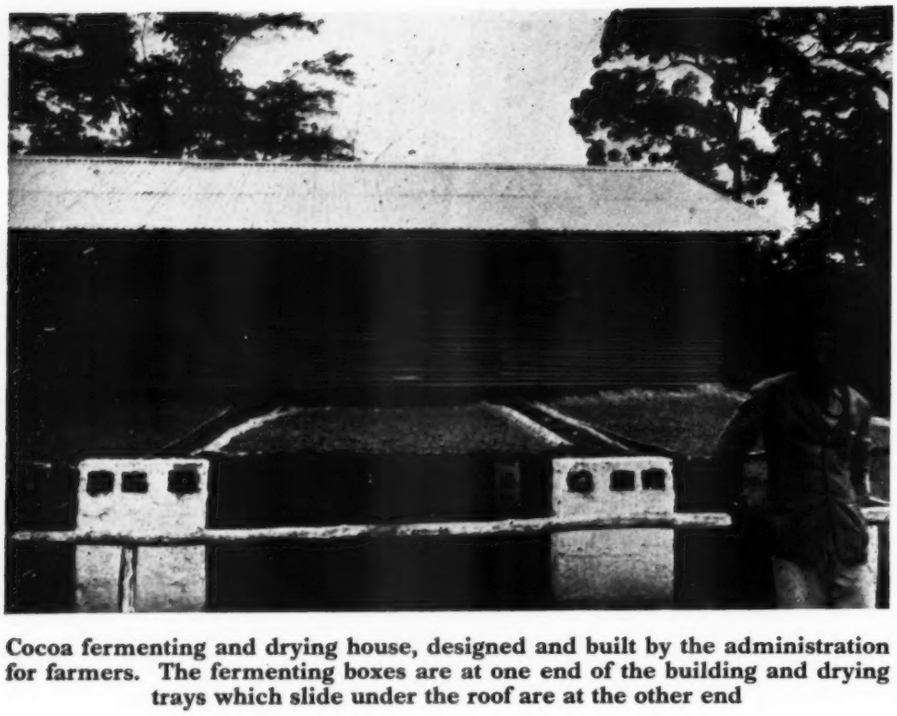
Cocoa butter factory

A factory for extraction of cocoa butter has recently been erected at Douala. It has a capacity for processing 4,500 tons of raw beans per annum. In addition to processing better quality cocoa, sub-grade cocoa which is not exportable is treated here.

Research

At Nkoemvone, near Ebolowa, there is a research station which is concerned exclusively with cocoa. The staff consists of a director (who is a geneticist), a plant pathologist, an entomologist and two agronomists. The station covers 50 acres, most of which are planted with cocoa under various forms of experimental treatment. The selection of superior planting material is one of the main concerns of the station. Selection so far is from local Trinitario material and some Forasteros. There is some material from other countries, including the Gold Coast.

The average yield of local trees is about 350 to 400 g. of dry cocoa per tree; the highest yield recorded for a selected tree is 6 kilos (13.2 lb.) of dry cocoa per annum.



Cocoa fermenting and drying house, designed and built by the administration for farmers. The fermenting boxes are at one end of the building and drying trays which slide under the roof are at the other end

The better selections are being multiplied vegetatively by rooted cuttings, which are being distributed to farmers. Various experiments are being conducted on fermenting and drying with a view to improving the quality and evolving efficient systems which can be easily adopted by the peasant farmer. A simple container for fermenting cocoa, consisting of an old wine barrel mounted on an axle and fitted inside with baffles which mix the cocoa when the barrel is turned, is being tested. The results are good and this form of container, which is easily operated, should be popular. Experiments are being conducted for the control of *Phytophthora* fungus and insect pests by spraying with Bordeaux mixture and DDT.

Conclusion

Under the influence of the French Government, the cocoa industry in the French Cameroons has developed very considerably. With the continuation of the present policy there seems no reason to doubt that the aim of producing 120,000 tons of cocoa from the land now under the crop will ultimately be achieved, while there are further considerable areas of land suitable for cocoa cultivation available for expansion beyond this limit. The future for cocoa in the territory, therefore, appears promising.

English Agricultural Machinery Census

The results of the January 1954 machinery census in comparison with those for January 1952 were published recently by the English Ministry of Agriculture. The report indicates that substantial progress in the mechanisation of agriculture is still being shown, although for many items the increase in numbers is smaller than during the period 1950 to 1952. The following paragraphs contain some brief comments on the principal figures.

With the exception of tracklayers under 10 h.p., all tractors show increases. The figures for tracklayers over 10 h.p. appear to be remarkably high in comparison with results for previous censuses and are subject to re-examination. For the first time, separate figures for tractors using different fuels are available. These show that, while the majority of both tracklayers and wheeled tractors are powered by vaporising oil engines, there are now more diesel-engined tractors in use than petrol-engined. (The majority of new tractors being sold in this country are diesel-engined.) Tractor trailers increased by nearly 36,000 (14%).

As tractor-drawn equipment has increased horse-drawn equipment has continued to show a steady decline; in particular, wagons and carts have decreased by 71,260 (over 20% of the 1952 total). There are also a number of instances where the more traditional machines show declines and the corresponding newer developments show increases, *e.g.* corn drills are being replaced by combined seed and fertiliser drills, binders by combine-harvesters and grinding mills by hammer mills. Horse ploughs and single-furrow tractor ploughs show reductions of 25,250 (21%) and 4,760 (10%) respectively; but two- and three-furrow tractor ploughs increased by nearly 12,000 (5%). Tractor cultivators increased by over 19,000 (13%), but some of this increase may be due to conversions of horse cultivators, which decreased by 11,700 (14%). Similarly, many horse mowers have probably been adapted for use with tractors and are now returned as tractor mowers.

The increase in the number of side rakes and swath turners—8,780 (6%)—is probably linked with the decrease of 10,630 (6%) in hay rakes.

The increase in combine harvester-threshers—4,650 (28%)—is rather lower than the increase shown in the period 1950-52, though it is still substantial, but for pick-up balers the increase of 8,560 (75%) is larger than for the previous period.

Other modern labour-saving developments, such as mechanical loading machinery and sugar beet harvesters, also show considerable proportionate increases, particularly tractor - mounted fork - type loaders, which increased by 73% to 12,130.

The greatest proportional increase between the 1952 and 1954 figures is shown by ground crop-spraying machines, the number of which has nearly doubled. This is, of course, the result of modern developments in the technique of weed control by spraying.

ECE Agricultural Committee

The Agricultural Committee of the United Nations Economic Commission for Europe (ECE) had its first meeting since March 1950 at Geneva on June 21. Leading experts from 19 East and West European countries, including Britain and the U.S.S.R., were present. The United States was also represented and Argentina sent an observer. After four years of deadlock the committee was reconvened as a result of the more hopeful atmosphere in the full session of the ECE in Geneva last March. The committee is expected to draft a plan for international action to expand agricultural production and to develop intra-European trade, particularly between East and West.

A New Design for Grain Storage Silos

A. G. THOMSON

The satisfactory storage of grain has long been a problem, connected with which is the protection of stored grain from insect attack. Hitherto practice has favoured vertical silos for this purpose. In this article there is described a new horizontal form of construction for grain storage silos which appears to offer a number of advantages over traditional practice.

THE development of the modern silo has provided a highly efficient method of storing large quantities of grain in bulk. The usefulness of this method, however, is limited by the cost of a fully mechanised silo, which may amount to as much as £20 or even £25 per ton of grain stored, and is seldom less than £10 or £11 per ton. To build a silo of the conventional type, therefore, involves a high capital outlay, partly because silos are primarily handling plants rather than stores and partly because the foundations, walls and supporting piers must be immensely strong.

Horizontal storage

The need for a more economic and flexible method has directed increasing attention to the possibilities of horizontal storage, notably in Australia and South Africa. This method consists essentially in storing the grain at ground level in long bulks retained by inexpensive walls instead of extending the building upwards by very expensive walls, as in an ordinary silo. By this means the capital cost of the building is substantially reduced, but a difficult handling problem is presented.

The height of a conventional silo allows grain to be discharged by gravity into conveyors and elevators and even directly into vehicles. When grain is stored horizontally, however, in quantities large enough to warrant mechanical handling it becomes necessary to install power-operated scrapers or portable augers and belts to move the grain, a method which has been widely adopted in Australia and the U.S.A. Alternatively, the store may be served by conveyors running the whole length of each horizontal bulk in troughs below ground level, provision being made for drawing off the grain from a number of different points.

Undesirable features

A horizontal grain store has usually several undesirable features and is frequently little better than a shed containing an improvised handling plant. The roof with its elaborate steelwork, the scraper machinery, or the inaccessible conveyors under the floors provide harbourage for dust and spilled grain. Such stores cannot be properly cleaned out and soon become infested with insects. Fumigation is impossible, because the building can never be made absolutely airtight, and it therefore becomes necessary to use insecticidal dusts, which are undesirable in proximity to food.

Maintenance of the large roof areas inseparable from horizontal storage is also a difficult and costly problem, since a grain store must be absolutely watertight.

A new type of storage

The limitations of both vertical silos and horizontal storage appear to have been successfully overcome by a new type of granary designed and patented by a British consulting engineer, Mr. John Hughes.* Though it can be constructed for a cost of £5 a ton or even less, this system offers a number of advantages which have hitherto been confined to conventional silos.

From the accompanying artist's sketch, a general indication of the layout can be obtained. It will be seen that the bins are grouped in a ring and each one is connected by a radial conveyor to a central machinery house containing an elevator and cleaning and weighing machinery. Because this arrangement bears some resemblance to a spider's web with a spider in the centre, this new type of granary has been named the ' Spider Web ' silo.

Details of construction

The bins have a high ratio of circumference to height and hold from 1,000 to 6,000 tons each, smaller subdivisions being made, if desired, by the addition of radial walls. Each bin has a hopper bottom, which is excavated into the ground and is lined with waterproof concrete. The roof and walls are of shell concrete without internal beams, columns or bracing.

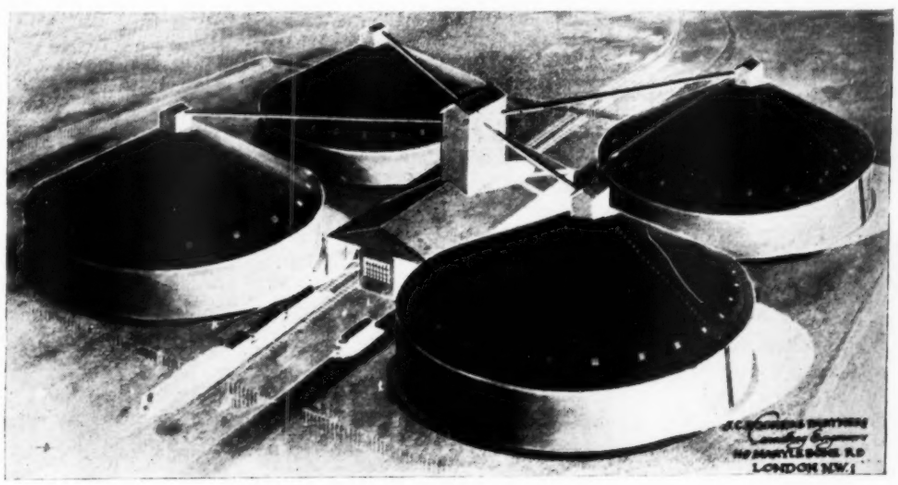
This design allows modern forms of construction to be employed, thus helping to bring down initial costs. By using bins of very large size the amount of wall per ton of grain enclosed is reduced. Moreover, an elevator or a pneumatic line can be provided for each bin, thereby eliminating the need for horizontal conveying at the bin discharge level.

Operation

The grain is fed to the bins by means of lightweight overhead conveyors, at a height which allows ample clearance for road and rail vehicles, which pass between the bins and the working house. It is discharged through a central elevator or a pneumatic tube at ground level.

Besides being economical in capital outlay, the ' Spider Web ' granary is cheap to run, because the handling arrangements, though simple, are complete. Grain is received, weighed, cleaned, put into store,

* Of J. C. Hughes and Partners, North West House, 119 Marylebone Road, London, N.W.1.



The Spider Web granary

fumigated, removed from the bins, weighed again, and delivered in bulk by a single man. The only operation for which further assistance is necessary is bagging off. By basing the handling arrangements on a central working house and excavating for the hopper bottom it has been possible to make extensive use of gravity, thereby minimising maintenance and reducing the possibilities of mechanical breakdown. The bins are completely self-emptying, so that perfect cleaning is assured without labour.

Insect control

One of the most essential requirements of a large grain store is effective insect control. In this respect the ' Spider Web ' granary is much superior to the usual type of horizontal store and even compares very favourably with conventional silos. This is because the bins are completely airtight and fumigation can therefore be thoroughly carried out. The most suitable method is spray fumigation, a fumigant which is liquid at ordinary temperatures being sprayed on to the grain surface by a fixed sprinkler system. The liquid trickles down through the grain and evaporates. It is also possible to use the standard European method of circulatory fumigation, in which a mixture of air and fumigant gas is blown through the grain mass.

This effective control of weevil eliminates one of the principal causes of heating. Trouble may occasionally be experienced, however, by the introduction of patches of damp grain. If an empty bin is available, the grain can be turned from one bin to another in the usual way. Should there be no empty bin the remedy is to ' revolve ' the grain, so that all grain liable to heating is passed through the conveying machinery. In a conventional silo bin this process does not turn the whole of the grain because of funnelling of the contents during discharge. In the wide bins used in this new type of granary the top of a typical funnel of moving grain is about two-thirds of the diameter of the bin during revolving. This width may be increased, if desired, by introducing an inverted cone in the hopper of the bin, so that the grain is discharged along an annular slit of any desired diameter. It is thus possible to ensure that the part of the bulk most liable to spontaneous heating is moved by the process of revolving as frequently as may seem desirable.

A final advantage of the ' Spider Web ' granary is that the bin roofs and grain surface may be fully ventilated, if desired, or the bin may be completely sealed and kept entirely without ventilation, so that uptake or loss of moisture to the atmosphere is minimised.

Conclusion

This economical and flexible system should find applications in all countries where large bulks of grain are stored and handled. Though maximum economy will obviously be achieved by storing a few varieties of grain in very large quantities, it is possible to provide a large basic storage with a number of smaller bins to hold individual farmers' supplies. Once these supplies have been accepted and (if necessary) put through a drying plant, they may be added to the main bulk or dealt with separately as preferred.

Mr. Harry Ferguson

It has been announced at Coventry that Mr. Harry Ferguson has resigned as chairman and as a director of Massey-Harris-Ferguson Ltd. in order to develop a number of new inventions—outside the agricultural machinery field—upon which he has been working for many years. As a consequence, he will no longer be responsible for the design of farm machinery, including agricultural tractors, implements and equipment, and industrial tractors, which will continue to be manufactured and sold by Massey - Harris - Ferguson Ltd. under the Ferguson name.

Mr. Ferguson has sold his interests in Massey-Harris-Ferguson Ltd. in order to concentrate the whole of his resources behind the new inventions. Following Mr. Harry Ferguson's resignation, Mr. James S. Duncan, who directs the world-wide activities of Massey-Harris-Ferguson Ltd. with the title of president, now becomes chairman and president of this organisation.

In the above photograph Mr. Duncan (*right*) is seen with Sir Geoffrey Clay and Mr. L. Harper.

British Weed Control Conference, 1954

The British Weed Control Conference, 1954, organised by the British Weed Control Council will be held on November 2, 3 and 4 at the Majestic Hotel, Harrogate. It will provide an opportunity for all those interested in the technology of weed control to hear of the latest developments and to present and discuss the results of their investigations and experiences. The conference president is Prof. Sir James A. Scott Watson, C.B.E., M.C., Chief Scientific and Agricultural Adviser to the Ministry of Agriculture and Fisheries. The conference will be residential, although registration with or without accommodation may be made. Provisional programmes and application forms may be obtained from the conference treasurer, Mr. W. A. Williams, Association of British Insecticide Manufacturers, Cecil Chambers, 86 Strand, London, W.C.2.

Mr. G. C. Denham

Mr. G. C. Denham, the author of the article ' The Tea Industry in Indonesia,' which appeared on page 314 of our August issue, was wrongly described as a C.M.G. This should have been C.B.E. Mr. Denham is now chairman of The Anglo-Indonesian Plantations Ltd.

Insecticidal Lacquers

N. G. SHREEVE, B.A. Agric. (Cantab.)

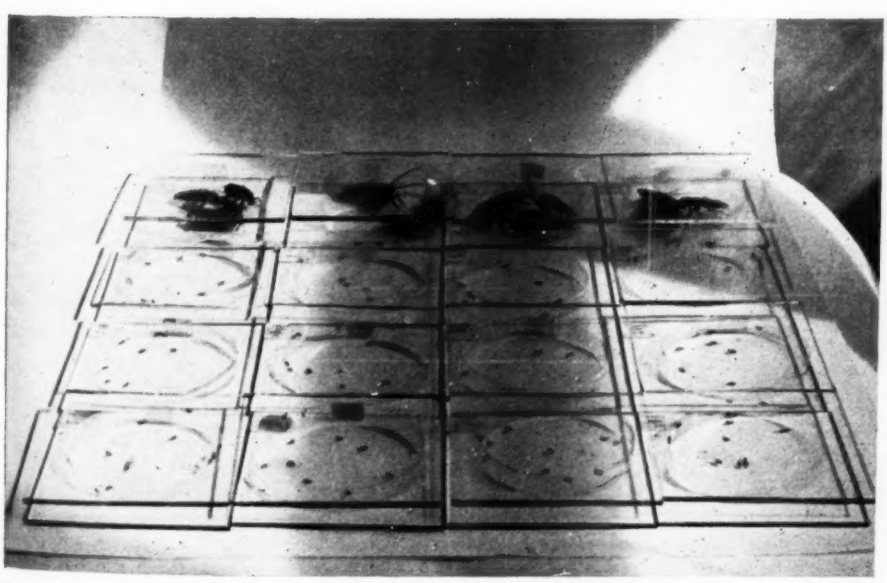
Metallurgical Chemists Ltd.

REFERENCES have already been made in the columns of WORLD CROPS to insecticidal lacquers, which must surely rank amongst the outstanding post-war insecticidal developments. Briefly, they are resinous lacquers which set to give a very hard surface which forms insecticidal crystals as a result of stimulation. Historically, the lacquers are a development of the early idea of incorporating DDT in paint. This, unfortunately, did not work, as the paint formed a hard skin which prevented the release of the DDT from the surface. As a result of research sponsored by the Government, there was evolved a series of lacquers based on urea formaldehyde resins in which surface stimulation caused insecticidal crystals to form a bloom on the surface. These inventions were made the subject of patent applications. At first, probably as a result of the original DDT work, the new invention was considered a paint. Such an outlook imposed considerable limitations on the concept of the value of insecticidal lacquers. The first essential is to realise that they are not a paint, but a type of insecticidal formulation with remarkable properties. Once this is appreciated the field of possible usage is immediately broadened and the full implications of the invention can be understood.

The use of lacquers containing insecticides for the control of insect pests is a recent development, an account of which is given below. The scope for the employment of the method, e.g. for the protection of stored products and similar purposes, seems to be considerable.

Nature of the lacquers

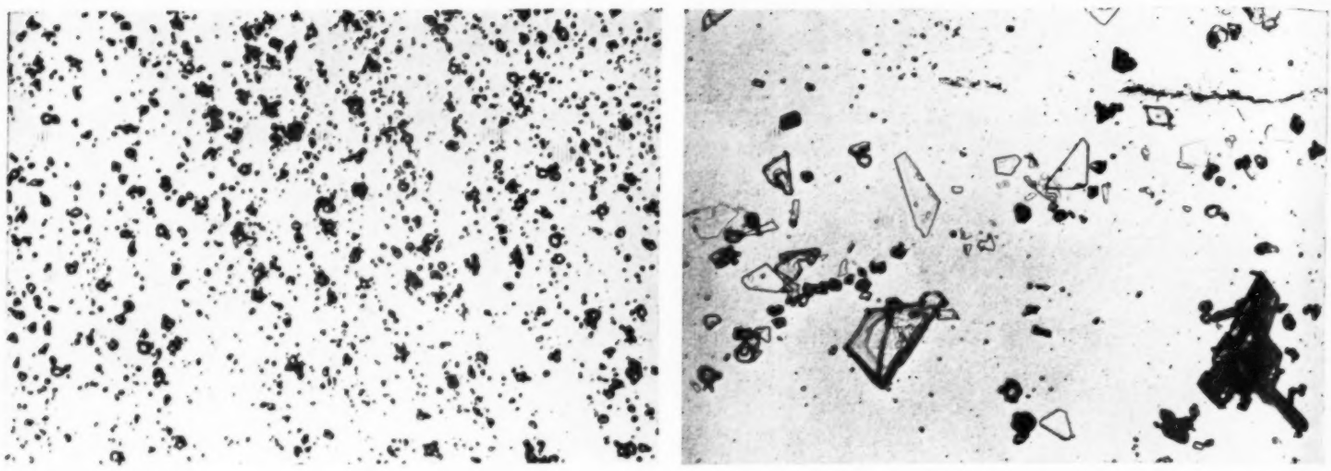
They are products of the interaction of urea formaldehyde resins and insecticides (or other types of pesticide). The pesticide used is governed to a certain extent by the interaction with the component resins, since certain types of pesticide are not suitable for use. The pesticide is held in the formulation as a super-saturated solution, and because of this a bloom of minute microcrystals is produced on the exposed surface of the lacquer. The size of these crystals varies according to the insecticide used, but they are much smaller than the crystals normally deposited from other methods of application, and they are more toxic to insects. If the surface bloom is removed by cleaning a further set of crystals is formed. This process can go on indefinitely until the supply of insecticide is exhausted. There is, therefore, no loss of effectiveness at the surface of the lacquer. The duration of effective life can be controlled by the method of formulation employed and by the quantity of insecticide incorporated, as well as by making use of insecticides of differing volatility. Standard lacquers work effectively for at least 12 months. The mode of action is not yet properly understood and requires very much more work. Initially, however, it would appear that the phenomenon of bloom is governed by the crystal size of the insecticide, its volatility and its solubility in the plasticiser. There may be a link between crystal size and solubility, but whether these two factors are independent is not known. At any rate, it appears that the insecticidal crystals within the resin can grow on the exposed surface, and it has been suggested that this does not impose the same mechanical restrictions as the internal molecules which prevent crystal growth. This, however, does not account for the uniform distribution of insecticide on the lacquer surface, nor for the response to stimulation. The fact that decreasing the content of plasticiser gives harder surfaces, which yield less insecticide, lends some support to the importance of the plasticiser, although it is not yet known if bloom is reduced by the increased hardness or by decrease in plasticiser, and hence the quantity of insecticide which can be carried in solution. The evidence tends to point to the latter case, as substitution of alternative solvents enables 'hard' surfaces to bloom freely. The whole problem warrants much more investigation.



A general view of a test being carried out with various insects with different lacquer treatments. After a given exposure the lower plate is removed and the insects left on a paper surface. In this way it is possible to estimate the rapidity of effectiveness of different types of lacquers

Compounding

In practice insecticidal lacquers consist of two parts: (*a*) the body of the material itself and (*b*) the accelerator. Before application the accelerator is added to the lacquer and this causes it to set hard. The hardening process takes about three hours and the working life of the accelerated materials is one and a half to two hours. After this the lacquer becomes stiff and unworkable. Standard lacquers have a coverage of about 80 to 100 sq. yd. per gallon, according to the nature of the surfaces to which they are applied. The surface is rather important, for while almost any hard surface is suitable, there are one or two exceptions, and these in-



These two illustrations (x 250) show effects resulting from artificial scrubbing (*left*) and the natural stimulation by insects (*right*) on lacquer-treated areas. The photograph on the left was taken about 30 minutes after treatment; while that on the right was taken 3 weeks after the surface had been exposed for 30 minutes to *Calandra granaria*. This accounts for the difference in crystal size since some of the spontaneously induced crystals have grown considerably

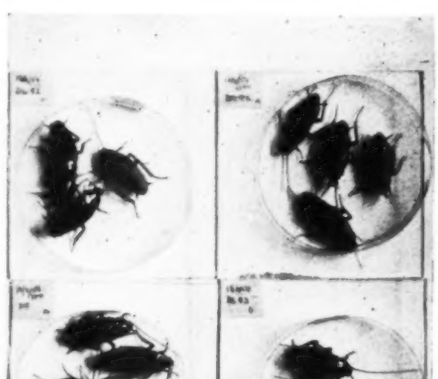
clude high-gloss and rubberised paints and highly absorbent surfaces. So far as high-gloss and rubberised paints are concerned, it would appear that there is some sort of chemical reaction, since it has been found that satisfactory results can be obtained from applications to very shiny surfaces, such as glass and china glazes. The point is not of great practical importance, since lacquers are completely clear and impart a high-gloss finish, and, therefore, application to a flat paint gives a high-gloss result.

Insecticides employed

There is considerable variation in the insecticides employed. One insecticide alone, however, is not usually sufficient, since it takes a considerable time to bloom, unless artificially induced by scrubbing. This difficulty is generally overcome by the incorporation of a second insecticide which is more volatile and therefore gives an immediate, if not so effective, result. Another consideration is the sightliness of the lacquer, since some insecticides bloom very freely and give a most unsightly effect, DDT being an example of this. On the other hand, the presence of visible bloom also serves as a guide to the continuing activity of the lacquer. It has been found that standard formulations remain active, if properly applied, for periods of 12 months or more, and on one occasion at least still remained active after 24 months. This puts a considerable strain on the faith of the consumer and it might be considered advisable to have a reasonably visible bloom so as to reassure the user of the truth of these claims.

Application

Insecticidal lacquers can at present be only applied in the same fashion as paint, another factor contributing to the ' paint ' outlook. They are easier than most paints to handle, until they start to harden, and can be put on by brush or roller. They can also be applied by spray gun, but when this method is employed the material is broken up into extremely small droplets and the resultant ' mist ' is poisonous. It is therefore necessary to wear a respirator when spraying; the service type respirator is satisfactory. Owing to the occurrence of depositions in the filter, it is advisable to fix detachable filter pads to the canister valve, and these can be renewed with the greatest of ease. The lacquers pass quite happily through a normal paint sprayer and this aspect presents no problem. As unpleasant fumes are given off during any type of application (these are not really worse than those associated with chemical paint strippers), it is important to secure the maximum ventilation possible during operations, otherwise the user may become affected. Standard lacquers have a flash point of 78° to 80°C., and thus it is essential to ensure that there are no naked lights in the vicinity of the treatment for at least three hours after application. The use of alternative components is making it possible to raise the flash point and work on this is proceeding. Once set, there is no greater fire hazard than with ordinary paint. A final operation needed is the cleaning of the tools; if this is left unattended, the resin will set and render brushes and rollers unusable and block spraying equipment. These have to be carefully cleaned after use with suitable solvents and it is worth noting that normal cleaning materials are not satisfactory.



Four panels of the American cockroach, *Periplaneta americana*. The insects are placed on a closed panel in a cellophane ring which is closed by a second glass panel placed on top

Surface treatment

Surfaces which are to be treated must first of all be thoroughly cleaned. More important still is the necessity of ensuring that treated areas are kept clean. Deposits of dirt, especially grease, will effectively prevent the lacquer from performing its proper function. Also, care must be taken not to overpaint treated areas, since this quite obviously has disastrous results. It may seem ridiculous to emphasise these apparently quite elementary points, but such errors have actually occurred, especially the last mentioned, on board ships, for some captains are accustomed to getting their crews busy with paint and brush rather than to see them unoccupied.

Practical employment

So far as practical applications are concerned, by far the bulk of work has been with anti-cockroach treatment in ships and shipping, and this concentration is partly due to the ' paint ' outlook already referred to. Other applications which have proved successful have been to domestic kitchens, industrial premises and to catering establishments, to mention a few. Prospects for the future include the treatment of aircraft to prevent the picking up of undesirable insects in transit, and also carrying such insects between two countries and the use of similar formulations for the control of fouling on ships' bottoms. Preliminary work on this has already proved satisfactory and some field trials are now in progress. There is no doubt that use for the control of flies, etc., in hospitals, and anti-malarial work in the tropics, to mention two items of public health concern, also provide undoubted possibilities, while another problem which is being tackled is a suitable lacquer to ant- and termite-proof wood. On a completely different level, it has been proved that these lacquers can be impregnated into cloth and paper to protect book bindings, and also that libraries can be successfully treated against the pests that infest them, either by direct treatment of the book bindings or of the shelves. This, of course, cannot control insects already in the books, but can control movement and further infestation and would certainly protect new books.

Conclusion

This article is only a review of insecticidal lacquers and thus many interesting problems and aspects have not been touched upon at all. It is hoped that it will serve to stimulate a greater interest and research and, above all, to draw attention to the fact that insecticidal lacquers are not paints, but insecticidal formulations of a revolutionary kind which provide very lengthy persistency and whose application is universal and not confined to shipping alone.

Raydex Cleaner

The Pennsylvania Salt Manufacturing Co. has produced ' Raydex,' a new cleaner for dairy and food processing plants and equipment. ' Raydex,' a granular alkaline formulation, is a 100% active cleaner designed for heavy-duty service in hard or soft water using either brush or spray method. It contains no inert material, filler or water. Completely free of abrasives and insolubles, ' Raydex ' is stated to be easy on equipment and will not mar polished surfaces.

The root rake at work

Mechanised Land Clearing

In continuation of the article on page 333 of the August issue of WORLD CROPS, we reproduce two photographs taken recently at a demonstration of mechanised land clearing organised under the auspices of the Hampshire section of the English National Agricultural Advisory Service on the farm of Mr. W. Leonard Hill at Crux Easton.

The machine shown operating is termed a root rake; it has been fitted in place of a bulldozer blade on the front of an Allis-Chalmers tractor. In the demonstration the implement very effectively uprooted trees up to a diameter of 3 to 4 in. It also was very efficient in piling the debris in readiness for burning and in removing roots from the soil. For removing roots left in the soil an implement termed a ' ripper ' is trailed behind the tractor, and behind the ripper is also trailed a set of heavy disc harrows to refine the land for planting.

The ripper has been modified to enable it to take special tines to do a variety of operations. To facilitate the handling of the larger timber use was made of a mechanically-operated bandsaw which can be manipulated by hand.

As a result of operations carried out during the last six months, about 55 acres of land have been reclaimed from scrub and coppice of no value and made ready for planting. The machinery is owned and operated by Mr. H. R. Nuding. The demonstration was attended by a representative gathering of farmers and landowners, who followed the operations with interest.

Visitors to the demonstration examine land after roots have been cleared

THE ROYAL SHOW

Some Photographs Taken at Windsor

The Royal Agricultural Show of England was held this year from July 6 to 9 in the Great Park at Windsor. A report of the show and a description of machinery exhibited appeared in our last issue. On this page we reproduce some photographs taken at Windsor by our staff photographer. (*Right*) A parade of champion horses in the grand ring

Among the most striking of the stands at the Show were those of Massey-Harris-Ferguson Ltd. (*above*), the Ford Motor Co. Ltd. (*right*) and Rotary Hoes Ltd. (*bottom right*). This combined mole-tile drainage exhibit was a feature of the Ministry of Agriculture stand (*bottom left*)

RESEARCH DEVELOPMENTS

Fertiliser Developments

RECENT progress in various aspects of research on fertiliser applications under English conditions is summarised in the recently published report of Rothamsted Experimental Station for the year 1953. We reproduce from the report statements which summarise the position in regard to the so-called nitrophosphate fertilisers and also recent developments in regard to fertiliser placement.

Nitrophosphates

In several countries compound fertilisers termed nitrophosphates are being made by using nitric acid in place of sulphuric acid to attack the phosphate rock; ammonia is added to neutralise the excess acid and form dicalcium phosphate and ammonium nitrate, but it is also necessary to reduce the content of soluble calcium salts still further. In one process excess calcium nitrate is removed before adding the ammonia. In others calcium sulphate is formed by using a mixture of sulphuric acid and nitric acid or by adding ammonium sulphate. As the products are granular, the important question arises whether the insoluble dicalcium phosphate can act quickly enough where early establishment and growth are important. Three kinds of nitrophosphate were compared in the co-operative trials of 1952 and 1953. All three nitrophosphates proved to be inferior to superphosphate for potatoes, especially on neutral soils. There were also marked differences between the three kinds of nitrophosphate, the one made by removing calcium nitrate being inferior to the other two. The grassland experiments were very insensitive, with negligible benefits from increasing the superphosphate dressing. Although the differences were very small, the order of the nitrophosphates was the same as for the average of the potato experiments. These results suggest that producers of nitrophosphate or similar fertilisers should not value the phosphate at more than about three-quarters of water-soluble phosphate. Further, it may be misleading in pilot-plant developments to rely on the citric acid tests. The product made by adding ammonium sulphate had 28% of its phosphorus in a water-soluble form, and the other two had almost none, but only 89% of its phosphorus was citric soluble compared with 100% and 96% in the two products which behaved less well in the field. The behaviour of dicalcium phosphate in granular fertilisers needs much more detailed investigation in the laboratory and the field in relation to the precise form of the crystals, the physical conditions of the granules and the nature of the other salts present before it would be safe to rely on laboratory methods to characterise the products. The necessary field work, laborious and expensive as it is, should be regarded as part of the developmental costs to be incurred before a new kind of phosphate fertiliser is introduced. For farmers and their advisers it would appear that the phosphate in nitrophosphate behaves in much the same way as that in high-soluble basic slags. These two classes of fertiliser have not been compared directly since they are normally used in different ways.

The general results of both series of experiments emphasise the outstanding merits of water-soluble phosphate on most, if not all, classes of land. Although other tests are needed for certain special classes of phosphate fertiliser, formal simplicity should not be secured at the cost of sacrificing the water-solubility test for superphosphate ammonium phosphate and mixtures based on them.

Fertiliser placement

G. W. Cooke, with F. W. Widdowson and J. C. Wilcox, tested a nitrophosphate (made with the addition of ammonium sulphate) against an equivalent mixture of granular superphosphate and ' nitro-chalk,' both lots being applied broadcast and combine-drilled. On the average of five experiments on spring cereals, nitrophosphate was of little value when broadcast and better, though still inferior to the superphosphate and ' nitro-chalk,' when combine-drilled. The mixture with soluble phosphate gave much better early growth than nitrophosphate. On very many soils cereals require phosphate only to ensure quick establishment and for this purpose water-soluble phosphates are much to be preferred.

In extending earlier work on methods of placement for PK and NPK fertilisers, experiments were made to test individual fertilisers. On the average of seven experiments on potatoes, ammonium sulphate at a light rate (0-5 cwt. N per acre) was better placed, whilst double this amount was better broadcast. Placing potassium sulphate (3 cwt. per acre) gave slightly higher yields than broadcasting in five or seven experiments.

There was no worthwhile advantage from splitting the nitrogen dressing, applying half at planting and half in the summer, over giving all of it at planting. In another series of experiments additional nitrogen as a top dressing gave only trivial increases in yield, even in areas where potatoes are regarded as maturing too early in the autumn.

In further experiments on horticultural crops placed fertilisers gave better results than broadcast fertilisers on lettuce, cabbage, beetroot, broad beans and runner beans. The benefit showed particularly well in the first cuttings of lettuce, French or runner beans and cabbage.

Much of the work on fertiliser placement has now reached the stage at which it should be extended to other areas not easily reached from Rothamsted. A useful beginning has been made in this direction in the East Province of the National Agricultural Advisory Service, in trials on threshed peas and also on peas picked green for market, canning or freezing.

Experiments on several crops have shown the advantage of placing moderate amounts of PK fertilisers near the seed. In a recent experiment on lucerne a ' starter-dose ' of superphosphate placed directly beneath the seed improved establishment and early growth. Many experiments on old arable soils have shown only small responses to normal dressings of phosphate fertilisers, and considerable economy could often be made by broadcasting a fertiliser rich in nitrogen and potassium and placing a small amount of water-soluble phosphate near the seed to promote early growth and to act as an insurance against an unsuspected deficiency of soil phosphate. Heavy manuring of potatoes and other more responsive crops often supplies unnecessarily large amounts of phosphate, and there is now a need for an additional national compound fertiliser with high N, low P, and high K or even for an NK fertiliser. For cereals P and K should always be applied by combine-drill, with nitrogen broadcast at rates limited only by the risk of lodging. Kale and similar forage crops require only moderate quantities of phosphorus and potassium, which could be applied as a ' starter-dose ' close beneath the seed, with nitrogen broadcast at seeding time or later, at much heavier rates than are commonly given.

Firestone Development in the North

Firestone Tyre and Rubber Co. Ltd. have announced the opening of a new district office at The Square, Stockton-on-Tees, with the object of providing a distributing point for their products in the Tees and North Yorkshire area.

CORRESPONDENCE

Systemic Insecticides

TO THE EDITOR

Dear Sir,

Your July number (Vol. 6, No. 7) contained an article by G. A. Emery, M.A., entitled ' Trials with Systemic Insecticides on Hops,' which described results obtained in some eight trials on the control of ' blight ' and red spider in hops during a single season. The author's findings in respect of one of the chemicals tested—demeton as ' Systox '—differ so markedly from our own observations and from published information (Zattler, F., *Höfchen, Briefe*, 4, (4): 131, 1951) concerning this product that we feel obliged to ask you to publish the following brief outline of our experiences with this material.

Experimental work in England using ' Systox ' (containing 50% demeton) was initiated in 1952 when 110 acres (14 sites) were treated by three different methods: (*a*) High volume spraying, (*b*) Low volume spraying and (*c*) Soil watering. At high volume rates of application it was shown that a dilution of ' Systox ' as low as 1 fl. oz. per 100 gal. would give 100% control of aphids under these experimental conditions and a knockdown within four hours of application. This contact as well as systemic effect was also apparent at low volume rates; knockdown was complete within 24 hours of application. By both techniques the effective life of the spray was shown to be 14 to 16 days, respraying thus being necessary at a shorter interval than three weeks. Commercial red spider control for 10 to 14 days was obtained by high-volume application at similar rates of dilution.

The outstanding systemic property of ' Systox ' was also brought out in these preliminary studies of the soil watering technique. Provided the sap was flowing, ' Systox ' was translocated to all parts of the hop bine within 48 hours of application.

Commercial development of ' Systox ' as our preferred treatment for ' blight ' and red spider control in hops followed and in 1953 well over 1,000 acres were sprayed with excellent results. Further extension of this use of ' Systox ' is now in progress during the current season. Rates of application advised are:

4 fl. oz. ' Systox ' per 100 gal. for high volume.

5 fl. oz. ' Systox ' in 25-35 gal. per acre for low volume application. For combined aphid and red spider control, a total of three applications is all that is required.

Contrary to Emery's conclusions, we are of the firm opinion that in ' Systox ' the hop grower has a systemic aphicide and acaricide which is unsurpassed in potency or economy. Furthermore, its striking contact action gives a quick suppression of the infestation; in this fact, if in no other, lies its superiority over schradan, which has no contact effect and whose systemic properties only become apparent four to five days after application.

Yours faithfully,

E. HOLMES.

Plant Protection Ltd.,
Bolton House, 61 Curzon Street,
London, W.1. *July* 16, 1954.

We have received a reply from Mr. G. A. Emery to the above letter which will appear in our next issue.

Silage Roller

TO THE EDITOR

Dear Sir,

I enclose herewith two photographs of a silage roller which I have devised to enable the sides and rear edges of my silage stack to be given a thorough consolidation without any danger to the tractor or tractor driver. You will see from the photographs that, as the roller is attached to the end of a hydraulic loader, the tractor can remain well inside the safe area of the stack while the roller itself, which weighs 10 cwt., does all the dangerous work. This implement has been in use throughout this season, and part of last season, on my farms and has met with complete success, not only while my stacks have been in the process of being built, but also after building has finished, when it has been used for the final consolidation and to form a nice flat surface. Needless to say, consolidation of the whole stack and not only the sides and the rear edge is carried out much more quickly and thoroughly with this implement than can ever be the case by using a tractor only.

I feel that if some of your readers may not have thought of using their hydraulic loaders for this purpose they might care to give this idea a trial, for I know that it does quite definitely solve one of the major problems of silage making.

Yours faithfully,

DOUGLAS SELIGMAN.

New Barn Farm,
Crawley,
Winchester, Hants.
July 10, 1954.

NEW BOOKS

Journal of the Royal Agricultural Society of England

Vol. 114. Pp. 183+81, illustrated. London. John Murray. 1953.

The motto of the Royal Agricultural Society, 'Practice with Science,' is well exemplified by the contents of this journal which consists in the main of a number of authoritative articles in which recent research work is described and related to practical farming.

The first part of the volume consists of nine special articles, commencing with an account of the Royal Farms at Windsor, followed by a most instructive study of animal behaviour and grazing management which points to the value of regular mowing and wilting of the sward and of harrowing after cattle have moved over the area, a system which makes the most use of the grazing area and leads to the improvement of the nutritive value of the sward.

Ley farming is regarded as a development of the one-year clover break in the Norfolk four-course rotation. The problems of extending ley farming are discussed in an article on Ley Farming and Corn Growing in the Midlands. The author emphasises the value of the system and produces convincing evidence that it is profitable. The ley is considered as the pivotal crop in the rotation, where the fertility of the land is built up.

An article is devoted to fodder beet in which varieties, methods of cultivation and economics are considered and the conclusion reached that if 20 tons per acre of fodder beet can be obtained the crop has prospects of extended planting in this country. The main virtue of fodder beet is that a good crop will produce 6,000 to 7,000 lb. of starch equivalent per acre, which is about three times the output from a really good crop of feeding barley. Against this is the fact that it is a crop with a high labour demand and does not lend itself to mechanisation on small farms where it promises to be most useful.

Following an article on the native hardwoods of Great Britain, which includes the ash, alder, beech, hornbeam and oak, is an account of the reclamation of upland marginal land in Herefordshire. Over 90% of marginal land reclaimed has been achieved by ploughing the existing sward, followed by cultivation, lime and fertiliser applications, and then sowing with a pioneer crop for grazing by livestock before sowing with grass. The usual pioneer crop is rape or turnip. The methods of reclaiming are discussed and the other shows the extent to which marginal land reclamation can contribute towards increased meat production. Other special articles include Recent Developments in Pig Breeding, Lucerne Fertiliser Trials in North-West Norfolk, and Recent Developments in Farm Budgeting—an article which merits particularly close study.

The second section of the volume, entitled Farmers' Guide to Agricultural Research, 1953, gives a concise account of recent scientific advances, expressed in non-technical language, and well documented by lists of references to recent literature to assist extended study of any aspect of recent research. The section is presented under the following headings, each of which is written by an acknowledged authority: Farm Economics, Crop and Plant Breeding, Soils and Fertilisers, Farm Implements and Machinery, The Feeding of Livestock, Diseases of Animals, Dairy Farming and Dairy Work. The section thus covers all the main aspects of farming in this country.

Bound with the volume is a full list of awards at the Society's Show at Blackpool in 1953, and the addresses of the prize-winners.

The present-day farmer cannot afford to hold himself aloof from the results of scientific research. The comprehensive survey of recent agricultural research contained in this journal offers him a convenient means of keeping up to date in this respect.

D. H. GRIST.

Methods of Surveying and Measuring Vegetation

By Dorothy Brown. Pp. xi + 223, illustrated. Commonwealth Agricultural Bureaux. 1954. 35s.

The estimation of the composition and the density of vegetation is steadily increasing in importance, and in publishing this book, which brings together for the first time the methods and techniques used in quantitative ecological studies of this type, the Commonwealth Agricultural Bureaux have rendered one more service to agriculture throughout the world. The book is written by Miss Dorothy Brown, who is a member of the staff of the Commonwealth Bureau of Pastures and Field Crops at Hurley in Berkshire.

Methods used in estimating vegetation are classified under three phases, namely, botanical analysis, productivity and utilisation. The methods described are in the main those which are applicable to the main types of grazing land that occur throughout the world.

The author has included practically all basic information available on the subject; she herself, in the introduction, admits to feeling some misgivings as to the method of presentation, but on the whole readers of the book will probably be satisfied that the lines she has followed are sound and well chosen.

The book itself will be a useful work of reference to all concerned with pasture improvement, particularly from the ecological point of view, and an invaluable guide to those called upon to make vegetational surveys in all parts of the world.

The Pests of Fruit and Hops

By A. M. Massee, O.B.E. D.Sc., F.R.E.S. 3rd Edition. Crosby Lockwood. London 1954. Pp 325. Frontispiece and 32 plates, 25s.

There appears from time to time a work which is hailed as an outstanding contribution to a particular subject or subjects and which is thus regarded as a 'bible' in its own field of influence. Such a work appeared in the realm of horticultural entomology 19 years ago under the title *The Pests of Fruit and Hops*, written by a great authority on the subject, Dr. A. M. Massee, at present head of the entomological section, East Malling Research Station. Since the publication of the first edition there have, of course, been great advances in entomological knowledge as related to fruit growing. As Prof. V. B. Wigglesworth states in his foreword to this book, 'the subject has been transformed.' Some pests which were of primary importance 17 years ago have now become of less significance, and *vice versa*. In that lapse of time also, new destructive pests have been discovered.

Especially in the sphere of insecticides have there been great advances. The number of such chemicals available and their potency have greatly increased in the intervening years.

In the third edition, Dr. Massee, with the assistance of Dr. G. H. L. Dicker and Messrs. R. P. Tew and Geoffrey Fletcher, has brought up to date the valuable information in his world-famous book. There is a chapter on the pests of each of the more important crops. The author gives in each case a complete list of the popular and scientific names of all the more important pests, clear guides to their identification in the field and descriptions of their life-histories and the control measures recommended.

Dr. Massee gives a clear and comprehensive survey of beneficial and harmless insect species. He stresses the importance of a more intense study of the effects of insecticides on the whole insect population,

and the necessity of including in spray programmes more selective chemicals than those in use at present.

A chapter contributed by Mr. R. P. Tew, A.R.I.C., is devoted to a discussion of insecticides, in which he describes the properties of the chemicals at present being used against insect and mite pests of fruit and the methods of formulation for application. Other chemicals, at present in the experimental stages, are also mentioned.

Mr. Geoffrey Fletcher gives detailed descriptions of the various types of modern spraying machinery and discusses the scope of each type of machine.

The book is amply illustrated with a number of excellent plates and there are numerous references to relevant literature. While it stresses the scientific basis upon which the suppression of orchard pests should rest, it is primarily a practical guide to growers towards the identification and economic control of the pests which threaten their orchards and hop gardens. No grower can afford to be without a copy for careful study and frequent reference.

E. F. S. SHEPHERD

Rothamsted Report

Report of the Rothamsted Experimental Station for 1953. Pp. 228. 1954. 7s. 6d.

The staff of this famous research centre has more than doubled since 1943 and it is certainly encouraging to learn from this latest annual report that building expansion to relieve congestion is actively in hand. At most of our research establishments, especially those classifiable one way or another as ' official,' post-war progress has been handicapped far more by lack of facilities than by shortage of scientists.

The 1953 report provides an abundance of evidence to justify all plans for expansion. Because Rothamsted's historic period was so closely identified with fertiliser development, it is sometimes assumed that its modern work is also primarily concerned with this branch of agricultural science. This is far from the truth. If the departments of plant pathology, entomology, nematology, bees, and insecticides and fungicides are grouped together, more than four times the number of scientific workers in the chemistry department are engaged in these biological fields. Indeed, the notable feature of modern Rothamsted is the increase in depth and width of the total agricultural research programme. Antibiotics in plant root disease control, the effect of leys upon soils' crumb structure, varietal resistance to eelworm, the first chemical isolation of the four active constituents of pyrethrum, the continued and now nearly completed study of particle size and nature (crystalline or colloidal) as an influence upon DDT's effectiveness, these are all Rothamsted projects. One of the three special survey type articles in the report deals comprehensively with the last topic. Further work on synthetic soil conditioners has been carried out by the Field Experiments Section, and in 1953 three such substances were tested; although clear effects upon the soil's physical condition could be observed during these tests, the yield increases (for carrots) measured have not been large, being insignificant at Rothamsted and no more than moderate at Woburn.

Some of the major fertiliser progress of 1953 is discussed elsewhere (see page 385), but the continued forest nursery/fertiliser studies of Rothamsted should also be mentioned. It is now clearly established that nitrogen for conifer seedlings should be given in the ammoniacal form, nitrate supplies proving to be consistently inferior. Indeed, the use of formalin to retard nitrification gives extraordinary increases in rate of growth. Less than 10 years ago chemical approaches to the nutrition of forest tree seedlings were highly suspect. The clarification of these special problems has been one of the many notable contributions of the late Dr. E. M. Crowther, whose premature passing is one of Rothamsted's severest blows. It is sad to realise that this must be the last annual report in which the Chemistry Department's section has been written by him.

D. P. HOPKINS.

Microbiology—An Introduction

By Ernest A. Gray. Pp. xii + 175, illustrated. Crosby Lockwood. 1954. 10s. 6d.

This little book is in reality an elementary textbook or, perhaps one should say, a guide to the whole science of microbiology. According to the publishers' announcement, it is not intended to compete with the many works that cover various aspects of the subject; it follows in general a plan adopted by the author in the course of his teaching at the Bayer's Biological Institute to students generally interested in the whole subject.

The book is clearly and interestingly written and can be recommended to anyone who wants a general introduction to the various branches of this subject, the importance of which is increasing almost daily.

Western Fruit Gardening

By R. M. Brooks and C. O. Thesse. University of California Press. 34s.

The western states, Washington, Oregon and California, comprise a wide range of climatic conditions. The mountains running from north to south divide the area into coastal regions of relatively high rainfall and inland regions of low rainfall, most of which comes in the winter months. In addition, as one passes from north to south the rainfall becomes progressively less, the summers warmer and the winters less severe, until on the south coast one finds frost in the winter a very rare occurrence. Altitude also plays an important part in modifying the climate.

These climates make possible the growing of many kinds of fruit, from oranges, lemons, guavas, olives, dates, etc., in some parts to apples, pears, cherries, plums, soft fruit, etc., in others. The authors of this book have included information on all these fruits, pointing out just where each can be successful grown and how far conditions may be controlled to suit the more difficult ones.

The book is divided into sections. The first deals with the planning and planting of the garden, the general care of fruit plants, and their training in various shapes. The second part lists 48 kinds of fruit, giving all the information needed to grow each successfully. The third part deals very briefly with pests and diseases and wisely refers the reader to the appropriate experimental station for full information on each.

The instructions and explanations are clear and are supplemented by detailed tables, diagrams and line drawings, which ensure that each point can be understood. There are no photographic reproductions, but the book loses nothing by their absence.

The authors are on the staff of the University of California at Davis and well qualified to write a book of this type. They have also drawn extensively on pomological literature from all over the world and must merit the gratitude of their readers for putting into print ' the best information on Western fruit gardening' yet published. Fruit gardeners in other parts of the world, even if they do not enjoy the wonderful climate of many parts of the Western states, will find this book refreshing and full of interest.

H. B. S. MONTGOMERY.

WORLD CROPS

IN OUR NEXT ISSUE, E. R. Webber will discuss the **Cultivation of Blueberries,** while the **Natal Wattle Industry** will be described by W. Williams. Other articles in this issue will include **Ramie Fibre: Its Cultivation and Development** by S. G. Willimott, and the **Mouldboard and the Land** by Norman Goodland.

FARM MACHINERY

The Agricultural Tyre Comes of Age

The land tyre and the tractor tyre were first produced for use in Great Britain 21 years ago. At the Highland Show (Dundee) and the Royal Show (Derby) of 1933 Dunlop's pneumatic land wheel equipment was awarded the silver medal in the new implement section. In the same year Britain's first practicable pneumatic agricultural tractor tyres were issued to farmers for full-scale tests.

The Ministry of Agriculture gave the official verdict on the tyres in a report published 21 years ago. It pointed out that the reduction which the tyres show in rolling resistance enables pay loads to be increased from 35% to 108%, depending on the soil conditions. The reason for such a marked improvement over the wooden wheels was, it stated, that the pneumatic tyre could spread itself over a larger area of ground and de-form locally. It sank less on soft ground, and so the wall of soil, which always faced the wheel which had produced a deep rut, was greatly reduced in depth, and less effort was therefore required to displace it.

Britain's first agricultural tractor tyre was offered to farmers for full-scale tests on the heels of the official recognition of the land tyre. The prototype of the tractor tyre had been put through severe tests the year before, and it is of interest to note today that this first tractor tyre was built to the same basic design of heavy tread bar now adopted by all manufacturers. The three essential features of the tractor tyre are:

1. It must be capable of converting the maximum torque of which the engine is capable, into draw bar pull with a minimum loss of energy on a large range of soil types.

2. It must not cut, tear or wear unduly under the normal conditions of operation. On roads it must not wear so rapidly as to impair its performance on soil.

3. Long exposure to sunlight, air and moisture under very considerable strains must not reduce its effective life through ageing of the rubber or rotting of the fabric.

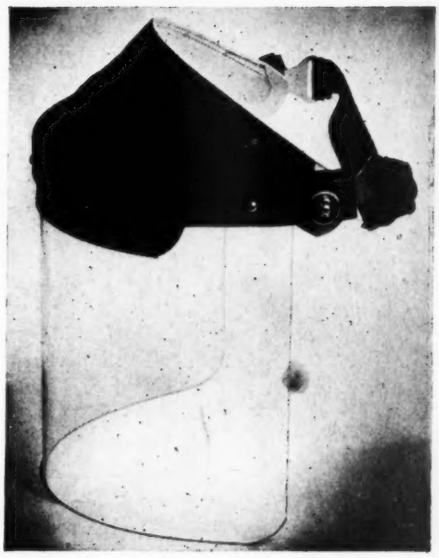
The advent of the tractor tyre, coupled with the development of the tractor trailer, has of course created a little revolution in agriculture. The official Ministry of Agriculture report stated that it has lessened rolling resistance by 69%; that on firm stubble and cultivated land fuel consumption was reduced by 5%; and that after 18 months of continuous service ' Dunlop tyres suffered no wear likely to reduce their performance.'

Recognition of the tyre's contribution to farming was marked by the award of the Royal Agricultural Society's silver medal for farm ' tractor wheels with pneumatic tyres.' Throughout Britain and all over Europe tractors were rapidly converted to pneumatics, and by 1939 the new equipment was virtually standard.

Overseas the land tyre has had a like success. Tyres for vehicles drawn by animals, sold with a complete equipment of hub brake and axle for loads varying from a 1-ton cart to a 6-ton waggon, were soon to be seen overseas on vehicles drawn by mules and bullocks, and even on carts drawn by camels. In a year the number of them increased tenfold and in another 12 months that total had almost doubled. The war held up further expansion, but it went on again in 1947 and nearly doubled next year, although overseas both South Africa and India were making not only the tyres themselves but also wheels, hubs and brakes. There are few countries to which the land-road tyres have not gone. Rhodesia, Denmark, and Holland are all considerable users and the sugar-growing islands of the West Indies found that, without laying down decanville tracks or miniature railway lines, they could develop their cane fields by using a range of sizes from the smallest to the largest on a string of carts pulled by a tractor.

It is, in short, not extravagant to claim that the yearly increase of food production throughout the world, depending as it does upon mechanised farming, would be impossible without the pneumatic tyre which made its appearance so recently as 21 years ago.

First experimental tyres being tested in 1933



The Jefco face screen

Jefco Face Screen

A new face screen for use while spraying is being carried out is now on the market. It is extremely light and protects the mouth as well as the eyes of the operator. The makers claim that ventilation through the hood entirely eliminates misting. The screen can be swivelled upwards clear of the line of vision, and another point to note is that the fittings are of nickel-plated brass which resists the corroding

Pest Control's new ' Major ' low-volume sprayer at work

effect of some formulations. There is a need for face screens in orchards and plantations and a cheap, hard-wearing model which can also be used in drilling, spot welding and grinding should have a wide appeal.

Low Volume Sprayer

Pest Control's new ' Major ' low volume sprayer has recently been added to the already comprehensive range of implements ' approved ' for use with the Fordson Major tractor. The machine has been specially designed for quick and easy attachment to the hydraulic linkage and tractor power-take-off. The 50 gal. capacity tank makes it possible to cover a large acreage with the minimum amount of lost time through running empty or refilling. Special synthetic treatment guards against corrosion in the tank which is fitted with a splash proof lid. The $\frac{3}{4}$ in. gear pump has a delivery capacity of $3\frac{1}{2}$ gal. per minute at 40 p.s.i. at 500 r.p.m. It consists of a gun metal casing, and non-corrodible bronze gears and stainless steel shafts give long trouble-free operation. An interesting feature is that the output of the pump can be doubled by reducing the tractor speed to 2 m.p.h.

For storage and transport the spray-bars fold vertically and give a 19 ft. 6 in. coverage in the spraying position. The bars are spring-loaded as a safeguard against damage by obstructions; for dealing with hedge-banks, etc., the booms can be set to spray at angles up to 45°.

Thirteen ' Teejet ' nozzles are fitted as standard and give 5 gal. per acre at 4 m.p.h. Alternative nozzles are available to give from 10 to 21 gal. per acre. To avoid nozzle stoppage three filters are provided; these are located in the tank filler, a ' T ' filter on the pressure side of the pump and in each individual nozzle.

With this machine a good operator should be able to spray 50 acres a day under average working conditions.

A New Hygrometer and Grain Moisture Tester

A new hygrometer has appeared on the market under the name of the ' Quick-test ' grain moisture tester and hygrometer. It is primarily intended for rapidly testing the moisture contents of stored grain but modifications are stated to be available for testing the moisture contents of hay, flour, timber and soil.

The instrument is produced by Opancol Ltd. and it is claimed that it enables the moisture content of grain and other materials to be rapidly measured with an accuracy of $\pm$ 0.4%. The instrument comprises a tubular stem which contains a hygroscopic element from which readings are transmitted to a dial at the top of the containing tube. Access to the interior of the material to be tested is obtained by a series of ports in the tube which can be opened and closed by twisting the dial. In use the instrument is inserted in the material, the dial is twisted to open the ports and, after an interval to enable equilibrium to be established, the moisture content is read off on the dial.

Two models are available, No. 2 with a 20 in. stem, for testing grain in shallow bins and sacks and No. 4 with a 40 in. stem, for use with grain in large bins or stacks. An improvement which is contemplated is the addition of a mercury thermometer attachment which will enable the actual temperature of the material to be checked, thereby detecting any dangerous heat increase in the mass.

Chance Engineering Division Change

J. Stone and Co. Ltd., electrical and mechanical engineers and founders, of Deptford and Charlton, have bought the engineering interests of Chance Brothers Ltd. of Smethwick. These interests include the manufacture of Sumo electrical submersible pumps, marine lighting and lighthouse equipment and fog signalling apparatus and Austinlite automatically-controlled electric generating plant, switches and instruments.

A new company will be formed, which it is intended shall be called Stone-Chance Ltd., with Mr. Bryan Preston, deputy chairman of J. Stone (Holdings) Ltd., as chairman, and Mr. John Raymond, who has up to now been managing director of Chance Brothers, as managing director. The two principal subsidiary companies, Sumo Pumps Ltd. and Austinlite Ltd., will continue to handle pumps and electrical equipment.

The reason for the sale is that the business carried on by the Engineering Division of Chance Brothers has over the years become remote from glass-making and the sale follows logically the separation last year of the management of the Division from those dealing with glass manufacture.

Technical News

Paint Manufacture for September will include ' Plant for Paint Manufacturers '—a review of recent developments in the plant used in the industry. Other articles in this issue will be ' Polyvinyl Butyral Resins ' by Gerhard Muller; ' Emulsions of Polymeric Materials ' by J. O. Cutter; and ' Carbon Blacks for Protective Coatings—4 ' by L. J. Venuto.

In the September issue of *Petroleum* there will appear ' Gamma-Radiography in Oil Installations—2 ' by C. C. Bates; ' Lubrication Problems in Relation to Ball and Roller Bearings ' by T. B. Sansom; and ' Prospects in Petroleum Chemicals —1 ' by John Seaman.

Among the articles appearing in *Corrosion Technology* for September will be ' Corrosion and Edge Cutlery ' by C. N. Kington; ' Measurement of Plating Thickness ' by G. Howells; and ' Painting for the Protection of Outdoor Structures ' by J. F. Stanners.

WORLD CROP REPORTS

WORLD

Wheat prospects. Prospects for the 1954 wheat crop at the end of June indicate that world production will probably be somewhat smaller than the near-record outturn of 7.15 billion bushels in 1953. Conditions in both exporting and importing countries were generally less favourable than at the same time last year, although exceptions are noted in some of the principal producing countries of Europe.

Exporters. In the principal exporting countries of the Northern Hemisphere wheat acreage in the United States and Canada will be less than in 1953, with the reduction especially marked in the United States as a result of acreage allotments. Current world crop prospects, however, indicate that there may be little or no reduction in wheat stocks in North America during the 1954-55 season.

Winter wheat acreage for harvest in the United States was estimated at 37.8 million acres. That is considerably below average and shows a reduction of about 9 million acres, or 19%, compared with the 1953 winter wheat acreage. In addition to that significant reduction, prospective acreage of spring wheat was down about 5 million acres from the large 1953 acreage, on the basis of farmers' intentions about March 1. If that cut materialises, total wheat acreage would be about 14 million acres less than the acreage harvested in 1953. Winter wheat yields were expected to show an increase from the 1953 average of 18.8 bushels at the beginning of June, which would mean a production of approximately 740 million bushels, 138 million bushels less than in 1953. Spring wheat production of 260 million bushels is now estimated. This is about 10% less than average, largely because of the sharp acreage reduction. That spring wheat outturn, with the indicated winter wheat crop, would mean a total harvest of 1 billion bushels, about 11% below the average of the 10 years ended 1952.

Intended acreage of wheat in Canada at the end of April was, at 24.6 million acres for winter and spring wheat, about a million acres less than the 1953 total wheat acreage. Of the total, 23.9 million acres represent intended seedings to spring wheat, with winter wheat acreage for harvest estimated at 0.7 million acres. Winterkill of fall-sown wheat was estimated at 4%, compared with 6% a year ago.

Wheat seeding for harvest in November-December 1954 was in progress in Argentina and Australia, the principal exporters of the Southern Hemisphere. Spotty dryness in Argentina slowed preparation of land for winter grain, which was being seeded there under fair conditions at the end of April. The acreage outlook is uncertain, with some trade sources predicting some diversion of acreage to grazing, because of more attractive cattle prices.

Good rains had fallen in many parts of Australia at the beginning of May and the soil was generally in good condition for preparation of the land for seeding. Rains were still needed, however, to put the soil in condition in New South Wales and Western Australia at latest report.

Most of the minor exporters report a favourable outlook. In France an acreage increase of about 750,000 acres over the 1953 area is reported. The increased acreage was maintained despite some damage from the January-February cold spell that made reseeding of some fields necessary in Northern and Eastern France. Crops were generally three weeks late because of cool weather. Yield prospects in mid-May indicated that yields may be at the record level of 1953, when yields averaged about 31.5 bushels per acre. Prospects point to an outturn of 330 to 350 million bushels, compared with 325 million in 1953. The outturn in Sweden this year is expected to be about 37 million bushels. This is about the same as the 1953 production, when the country was on a net export basis.

Wheat acreage in French North Africa is substantially larger than in 1953. Increases are noted for each of the three countries comprising the area, but the increases are largest in Algeria and Tunisia. Yields in Algeria are estimated to be about the same as they were in 1953 and the official estimate of the crop is 40.4 million bushels, compared with 39.5 million last year. No production estimates are available for French Morocco, but the current acreage estimate is 3,334,000 acres, compared with 3,269,000 last year. Acreage for Tunisia is estimated at 2,323,000 acres, compared with 2,029,000 in 1953.

Conditions have been less favourable in Turkey, where an exceptionally dry fall delayed operations and prevented seeding the full winter wheat acreage intended. However, conditions in the early spring favoured grain seeding, and increased spring-sown acreage may have largely offset the decline in fall-sown acreage. Development of the fall-sown crop was retarded by the dryness and unless the remainder of the growing season is exceptionally favourable the crop is expected to be 10% to 15% less than the record 1953 harvest.

Growing conditions have been unusually favourable in Iran and wheat there has made very good growth. Prospects point to a wheat crop at least 20% above the 1953 outturn. So far as is known, Iran has not yet disposed of any of the estimated surplus of 3.7 million bushels from the 1953 crop. The wheat crop in Syria is also reported to be good, with significant quantities available for export.

Importers. The outlook is generally promising in the principal importing countries of Europe. Throughout Spain prospects are excellent, with preliminary forecasts placing the crop at about 165 million bushels. The outlook for the wheat harvest in Portugal was excellent at latest report and a crop at least as large as in 1953 was expected. In Italy also the outlook has been excellent, with little damage apparent from the unseasonably cool weather. Recent forecasts place the probable outturn at a minimum of 295 million bushels.

The wheat crop in Western Germany is expected to be somewhat below the good 1953 harvest despite an increased acreage. The severe winter caused considerable damage to fall-sown crops and about 18% of the winter wheat acreage had to be reseeded, according to official estimates. Dry weather during the winter and spring months also reduced prospects. The 1954-55 wheat import requirement is roughly forecast at about 2.5 million tons. Spring seeding in Austria was three to four weeks later than normal. Wheat acreage for that country is estimated to be about 588,000 acres, which is well above the total acreage harvested in 1953. Winter wheat acreage was well developed and frost damage was estimated to affect about 10% of that acreage. The 1954-55 wheat import requirement is currently estimated at 210,000 to 260,000 tons.

Reports state that the condition of the wheat crop in the United Kingdom is good despite low temperatures, which have retarded growth and made the season generally late. Winter wheat acreage seeded to December was about 1.5 million acres, compared with 1.6 million for the comparable period of 1952. The decline was mainly attributed to uncertainties resulting from decontrol of the grain trade. Most of the approximately 1 million ton wheat reserve carried by the Ministry of Food will have been liquidated during the 1953-54 season and demand should then rise. Wheat acreage in Eire is estimated at 425,000 acres, about 10% above the 1953 area. Early-sown winter wheat showed good progress at latest report.

Prospects for the wheat crop in Yugoslavia are considerably less favourable than at this time last year and the harvest may

be as much as 25% below the 1953 crop. In Rumania and Hungary crop conditions have been similar to those in Yugoslavia. Prospects for Greece point to a smaller wheat harvest than the record crop of 1953. Winter wheat acreage was very slightly below the large 1953 acreage, but yields are expected to be about 10% below the record yields last year. Even at that level the harvest would be a near-record one if the season continues favourable.

Larger seedings of wheat in the Low Countries, Belgium and Netherlands, offset unfavourable growing conditions in those countries. Acreage in Belgium was tentatively set at 504,000 acres, compared with 411,000 acres harvested in 1953. Present acreage of 222,000 acres in the Netherlands compares with 161,000 acres harvested last year. Production in the latter country is forecast at about 11 million bushels, compared with 9.5 million in 1953.

The outlook for wheat in Mexico is good and unofficial forecasts place the crop at about 27.5 million bushels, compared with 23.9 million in 1953. On the basis of current prospects, the 1954-55 wheat import requirement is expected to be sharply lower than the 350,000 to 450,000 tons level of imports in earlier post-war years (1950-51 to 1952-53).

Preliminary reports place the wheat crop in Japan at about 48 million bushels. This is about 5% below the 1953 harvest and is also below average, with the reduction attributed to reduced acreage. The foreign exchange budget for April 1954 to March 1955 includes provision for about 1,750,000 tons of wheat, compared with 2 million tons imported in 1953-54.

Production of all food grains in India during the 1953-54 agricultural year is tentatively estimated at 55.3 million long tons. This total is significantly higher than the preceding year's good production of 46.9 million tons. There was a grain acreage increase of approximately 9 million (200.6 to 209.3) from 1952-53 to 1953-54. Wheat imports thus far in 1954 have been small.

Foreign Crops and Markets.

EUROPE

Sugar beet. The area under sugar beet this year in Europe (excluding the Soviet Union) is now estimated at 2,551,700 hectares by F. O. Licht. It compares with this authority's April estimate of 2,539,500 hectares and 2,511,500 hectares planted last year. The area in the Soviet Union is again put at 1,300,000 hectares.

It is stated that in many instances field progress is behind the average, with gappy fields greater than usual. On the other hand, the condition of the beet is up to average. Licht's estimate of beet sugar production last year (issued late in 1953) put the crop at 9,898,500 metric tons, against 8,271,300 tons in 1952. The Soviet Union crop (which was not included in this total) was 3 million tons.

The following table gives the area for Western Europe, with comparisons (in thousands of hectares):

Country	*June estimate*	*April estimate*
West Germany ..	246.3	245.0
Austria	43.0	42.0
France	320.0	315.0
Belgium	59.5	57.0
Netherlands ..	75.0	70.0
Denmark	49.6	49.6
Sweden	63.5	59.0
Italy	220.0	225.0
Spain	105.0	105.0
Switzerland ..	5.4	5.4
United Kingdom	162.0	162.0
Eire	29.0	29.0
Finland	16.5	16.5
Turkey	70.9	73.0
Total — Western Europe	1,465.7	1,453.5

ENGLAND AND WALES

Agricultural report. Agricultural conditions in England and Wales on July 1, 1954, have been summarised in a report by the Ministry of Agriculture.

Corn crops were generally satisfactory and expected to yield about average. Early potatoes were also expected to yield about average. Grass became plentiful during the month, but unsettled conditions delayed the start of haymaking; estimates of yield per acre of hay were slightly lower than last year. Roots were retarded by unfavourable weather and mangold fly was troublesome. Cattle and sheep did well.

The weather during June was changeable and cool. Rainfall was heavy at times, with thunderstorms in many areas.

Corn crops. Winter wheat was generally satisfactory. Reports from some districts indicated the presence of mildew, rust or loose smut, but disease did not appear to be unduly prevalent. Spring wheat continued to improve and was generally strong and healthy. Winter barley was satisfactory on the whole. Spring barley made good progress during the month; mildew and loose smut were reported from some districts. Winter oats were generally satisfactory, although a little thin in some districts. Spring oats improved during the month, but some later sowings were very variable. Damage by frit fly was reported from a few districts. Rye was healthy and promising.

Winter beans made good progress during the month; a few instances of chocolate spot were reported, but attacks were not serious. Spring beans were generally healthy. Peas were generally satisfactory, but damage by weevil and pigeons continued to be reported from some districts.

On the basis of crop conditions at the end of June the yields per acre of cereals, as well as beans and peas for stock-feeding, were expected to be about average.

Potatoes. Early potatoes made good growth during June and were generally, healthy. Lifting began in many districts but was later than usual; yields were expected to be about average. Second early and maincrop potatoes were healthy, but backward in several areas.

Sugar beet was retarded by unfavourable weather and sun was needed to develop the crop. Damage by mangold fly was reported from several areas.

Roots. Turnips and swedes made satisfactory growth; fly was troublesome in a few districts. Mangolds were retarded by slow growing weather, and also attacks of mangold fly which were unusually prevalent in many areas. Weeds were troublesome and sunshine was needed. Fodder beet was slow to make growth and damage by mangold fly was reported from several areas.

Kale made satisfactory progress on the whole. Weeds were troublesome and some damage by pigeons and flea beetle was reported.

Hay. Unsettled weather delayed the start of haymaking and in many districts cutting did not start until late in the month. Very little was carted. Reports indicated that more silage than usual was being made. The yields of hay from temporary grass and lucerne were forecast at 31.6 cwt. and 43.9 cwt. per acre respectively, as compared with yields of 31.9 cwt. and 44.5 cwt. in 1953. The yield of hay from permanent grass was expected to be 21 cwt. per acre, as compared with 22.5 cwt. last year.

Pastures made good growth during June and grass keep was plentiful.

ISRAEL

Grain and fodder. 144,000 tons of grains for fodder and 40,000 tons of wheat are expected to be harvested this year in Israel, according to a recent announcement of the Ministry of Agriculture.

In Jewish farms and settlements 600,000 dunams of barley were sown—75% of the area sown being in the south and the Negev — and about 150,000 dunams were sown in Arab farms. The average yield per dunam was 110 kg. in the south and the Negev, 150 kg. in Jewish farms and settlements in other parts of the country, and 100 kg. in Arab farms. The total yield of barley this year was 87,000 tons.

It is estimated that the area sown with wheat this year is 350,000 dunams, of which 200,000 dunams are in Jewish farms and settlements.